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Natural Hazards Evaluation of Existing Buildings

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Natural Hazards Evaluation of Existing Buildings

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ABSTRACT

A methodology is presented for survey and evaluation of existing buildings to determine the risk to life safety under natural hazard conditions and estimate the amount of expected damage. Damage to both structural and nonstructural building components resulting from the extreme natural environments encountered in earthquakes, hurricanes, and tornadoes is considered. The methodology has the capability of treating a large class of structural types including braced and unbraced steel frames, concrete frames with and without shear walls, bearing wall structures, and long-span roof structures. Three independent but related sets of procedures for estimating damage for each of the natural hazards are included in the methodology. The first set of procedures provides a means for qualitatively determining the damage level on the basis of data collected in field surveys of the building. The second set utilizes a structural analysis of the building to determine the damage level as a function of the behavior of critical elements. The third set is based on a computer analysis of the entire structure. All three sets of procedures are based on the current state-of-the-art. The procedures are presented in a format which allows up-dating and refining. Numerical examples illustrating application of the procedures are included.

Key Words: Buildings; damage; disaster; dynamic analysis; earthquakes; hurricanes; natural hazards; structural engineering; tornadoes; wind.

SI Conversion Units

In view of present accepted practice in this technological area, U.S. customary units of measurements have been used throughout this report. It should be noted that the U.S. is a signatory to the General Conference on Weights and Measures which gave official status to the metric SI system of units in 1960. Readers interested in making use of the coherent system of SI units will find conversion factors in ASTM Standard Metric Practice Guide, ASTM Designation E-380-72 (available from American Society for Testing and Material, 1916 Race Street, Philadelphia, Pennsylvania, 19103). Conversion factors for units used in this report are:

	Customary Unit	International (SI), Unit	Conversion Approximate
Length	inch (in)	meter (m)[a]	1 in=0.0254m
	foot (ft)	meter (m)	1 ft=0.3048m
Force	pound (lbf)	newton (N)	1 lbf=4.448N
	kilogram (kgf)	newton (N)	1 kgf=9.807N
Pressure Stress	pound per square inch (psi)	newton/meter^2	1 psi = 6895N/m^2
	Kip per square inch (ksi)	newton/meter^2	1 Ksi = 6895 x 10^{6}N/m^2
Energy	inch-pound (in-lbf)	joule (J)	1 in-lbf=0.1130 J
	foot-pound (ft-lbf)	joule (J)	1 ft-lbf=1.3558 J
Torque or Bending Moment	pound-inch (lbf-in)	newton-meter(N-m)	1 lbf-in=0.1130 N-m
	pound-foot (lbf-ft)	newton-meter (N-m)	1 lbf-ft=1.3558 N-m
Weight or Mass	pound (lb)	kilogram (kg)	1 lb=0.4536 kg
Unit Weight	pound per cubic foot (pcf)	kilogram per cubic meter (kg/m^3)	1 pcf=16.018 kg/m^3
Velocity	feet per second (ft/sec.)	Meter per second (m/s)	1 fps = 0.3048 m/s
Acceleration	feet per second squared (ft/sec^2)	meter per second squared (m/s^2)	1 ft/sec^2 = 0.3048 m/s^2

[a] Meter may be subdivided. A centimeter (cm) is 1/100 m and a millimeter (mm) is 1/1000 m.

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1. INTRODUCTION

1.1 BACKGROUND

Much of the loss of life and property in the United States from natural hazards such as earthquakes, hurricanes, and tornadoes results from the inadequate performance of buildings in response to these extreme natural environments. Past observations have shown, however, that buildings properly designed, detailed, and constructed can withstand these environments. This involves realistic assessment of the forces produced by the environment, proper distribution of these forces to structural and nonstructural building components and providing the necessary resistance to these components in the design process, and continual inspection during construction to insure the design is correctly executed in the field.

Improved building practices incorporating new knowledge relative to natural environments and the performance of buildings will serve to mitigate future losses. Continued updating of building codes and standards, taking into account the latest research findings and experiences gained from past performance of buildings, is one aspect of improved practice. Improved practices, however, apply only to future construction. They do not affect existing buildings. The response of an existing building to an extreme natural environment will reflect the performance level inherent in the codes, standards, and construction practices in existence at the time of design and construction. During the life of the building, building practices continually improve reflecting the advancement of the state of knowledge. Thus, the real margin of safety differs from that assumed at the time of design as the state of knowledge and building practices advance. Also, deterioration during the service life of the building affects the real margin of safety. The need exists, therefore, to continually evaluate buildings with respect to the potential hazard they pose when subjected to extreme natural environmental conditions. Following such an evaluation, appropriate rehabilitation or abatement procedures may be initiated to mitigate unacceptable hazards.

Several programs aimed at evaluating the hazard posed by existing buildings in the event of an earthquake have been initiated. The city of Long Beach, California adopted an ordinance in 1971 requiring an evaluation of the earthquake safety of all buildings within the city. Procedures for conducting this evaluation, a hazard potential rating system, and alternative actions for hazard reduction were developed by Wiggins and Moran [1.1].*

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*See references listed in Chapter 6.

Following the 1971 San Fernando earthquake, the Veterans Administration undertook a program to evaluate the seismic resistance of the VA hospital facilities located in earthquake prone regions which had not been designed to resist earthquake forces [1.2]. The Naval Facilities Engineering Command has also undertaken a program to evaluate existing naval facilities [1.3]. Several studies are underway in California, including projects in San Francisco and Los Angeles dealing with existing school buildings. Although these programs are similar in nature, each uses a somewhat different method of evaluation. Furthermore, since these methods involve evaluating buildings in accordance with the requirements reflected in current building codes, they do not provide an indication of the level of risk or explicit levels of building performance in terms of life safety, protection of property, and maintenance of vital functions. They also do not provide an estimate of the amount of building damage to be expected.

Despite these current diverse activities, knowledgeable professionals recognize that "there presently are no nationally recognized effective, systematic and economical procedures for assessing the hazards of existing buildings for future loads"[1.4]. Recognizing this, the National Bureau of Standards and the Defense Civil Preparedness Agency initiated a project in June 1972 as part of the Cooperative Federal Program on Building Practices for Disaster Mitigation to develop a methodology for survey and evaluation of existing buildings to determine the risks to life safety under natural hazard conditions. While it is intended that the methodology will be incorporated into DCPA's National Shelter Program, its application can be extended to similar programs in the public and private sectors.

This report presents the methodology including the technical rationale involved in the development, instructions for applying the methodology and numerical examples illustrating its application.

1.2 OBJECTIVES OF SURVEY METHODOLOGY

The methodology developed herein deals with survey and evaluation procedures for existing buildings to determine the risk to life safety under natural hazard conditions. While the safety of building occupants cannot be evaluated directly as a consequence of a particular natural event, it can be related to building performance and resulting damage to the building. For example, partial or total collapse of a building involving structural damage and damage to nonstructural elements are potential hazards to the lives of the occupants.

In developing the methodology, consideration was given to establishing economical procedures applicable to a large number of buildings and a wide variety of structural types. It was designed for nationwide application. In meeting these requirements, evaluation procedures consistent with current professional practice reflecting the state-of-the-art were incorporated in the methodology. The procedures are presented in a format which will facilitate incorporation of new knowledge as it becomes available. The elements comprising the procedures are presented in a modular form so that each element can be updated separately.

The methodology may also be used to evaluate the effects of alternative rehabilitation techniques for hazardous structures. It thus provides a tool for upgrading existing buildings by identifying items needing strenghtening or repair.

1.3 SCOPE OF SURVEY METHODOLOGY

The natural hazard loading conditions considered in this methodology are those encountered in earthquakes, hurricanes, and tornadoes. While the source mechanism is different for each of these geophysical processes, they all impose dynamic loading. Existing historical seismic and meteorological data are used in the methodology for determining the magnitude and recurrence interval for these hazard loadings. For earthquakes, recorded seismic data were used to prepare seismicity tables for determining expected ground motion, see Appendix G. For wind loading, recently adopted standards are used. Selection of the hazard loading for a particular building evaluation must be made by the user. The loadings provided with the methodology or appropriate values supplied by the user may be employed.

The types of structures considered include braced and unbraced steel frames, concrete frames, shear wall structures, combination frame and shear wall structures, bearing wall structures, and long-span roof structures. Although no specific limitations are imposed on application of the methodology, it is intended for buildings with substantial occupancy, i.e., fifty or more people. One-and two-story residential buildings, therefore, are not considered.

For surveys involving a large number of buildings, it is advantageous to utilize several different techniques to expedite the evaluation process. For example, due to age and type of construction, certain buildings can be easily identified as potentially hazardous without resorting to a rigorous analysis. Other buildings, because of their functional nature and structural type, may warrant a detailed analysis. In view of this, three sets of evaluation procedures were included in this methodology, each set representing a different level of analytical sophistication. Hereafter, these three sets are referred to as the Field Evaluation Method, the Approximate Analytical Evaluation Method and the Detailed Analytical Evaluation Method.

In the Field Evaluation Method buildings are evaluated on a qualitative basis in terms of structural characteristics, structural configuration, and the degree of deterioration of the building. Information on these are obtained from a field survey. This method provides a rapid, inexpensive means for identifying clearly hazardous structures or potentially hazardous ones requiring a more detailed analysis to estimate damage.

In the Approximate Analytical Evaluation Method, buildings are evaluated in terms of the behavior of critical structural members. The procedure requires an analysis of the structure to identify critical members and determine the stress level induced in these members by the extreme environments. A set of building plans, specifications, and construction drawings are needed to obtain the necessary data required to perform the analysis The method can be used to determine the damage level for buildings identified by the Field Evaluation Method as requiring further analysis.

In the Detailed Analytical Evaluation Method the damage level is evaluated on the basis of the energy capacity of the structure. This procedure requires the use of a digital computer program for the evaluation. As in the Approximate Analytical Evaluation Method, the building data needed for input to the computer program would be obtained from a set of building plans, specifications and construction drawings. It is envisioned that this procedure would be used for more complex structures or critical facilities such as hospitals, communication centers, etc.

In all three methods, an acceptable level of damage is not specified since it varies with the usage and function of the building. For example, while damage to partition walls in an office building causes an obvious economic loss and possible life safety hazards, similar damage in a hospital may cause a significantly greater life safety hazard. Thus, interpretation of levels of damage predicted by the methods as they relate to life and property losses must be exercised by the user.

1.4 ORGANIZATION OF THE REPORT

The first part of the report deals with the technical basis and rationale involved in development of the methodology. The second part illustrates application of the survey and evaluation procedures included in the methodology. The first part includes chapters 2 through 4 and the second part, the Appendices.

Chapter 2 discusses, in general terms, the factors which must be included in a hazard evaluation of existing buildings. Natural hazard loadings arising from earthquakes, hurricanes, and tornadoes are discussed. The current state of knowledge on modeling techniques for various types of structures and analytical methods for evaluating structural response to dynamic loading are also included. The failure modes for structures subjected to each of the three natural hazard loadings are described.

Chapter 3 outlines the development of each of the three evaluation methods including the manner in which the various factors discussed in chapter 2 were taken into account in each method. The assumptions and limitations of each method are discussed. The effective use of the three methods for surveying a large number of structures is also considered.

Chapter 4 includes an illustrative example of a building evaluated by each method for earthquakes, hurricanes, and tornadoes. For each natural hazard considered, the structure is analyzed for these extreme environments and the results obtained from each method are compared.

Appendix A includes the Data Collection Form for the Field Evaluation and Approximate Analytical Methods and instructions for collecting the data in a field survey. A completed sample form is given for illustration.

Appendix B contains the procedures for the Field Evaluation Method. The manner in which building data are considered in the evaluation procedure and definition of the structural and nonstructural quality rating schemes used are included.

Appendix C contains the procedures for the Approximate Analytical Evaluation Method. It describes data needed for this method. Procedures for identifying critical members in a structure are presented.

Appendix D contains additional examples of completed data collection forms and analyses by each of the three methods.

Appendix E contains the computer program user's manual for the Detailed Analytical Evaluation Method.

Appendix F contains a listing of the computer program for the Detailed Analytical Evaluation Method.

Appendix G contains United States Seismicity Tables obtained using the theory presented in the Detailed Analytical Evaluation Method.

2. FACTORS AFFECTING NATURAL HAZARD EVALUATION

2.1 GENERAL

This chapter presents the reader with a brief overview of the different components which are present in a damage evaluation methodology. The physical character of the natural disaster loading mechanisms is summarized in section 2.2. This is followed by a general introduction to structural modeling (section 2.3) and structure response (section 2.4). Section 2.5 presents a pictorial description of the damage induced by the past occurrence of major natural hazards.

2.2 NATURAL HAZARD LOADINGS

A. Earthquake Loading Considerations

Through much of seismic mythology two ideas recur. The first of these is that something was imprisoned within the earth -- a whale, a giant mole, a storm, or the monstrous children of Mother Earth. The second is that earthquakes had something to do with the sea; in Greek mythology, Poseidon, brother to Zeus and god of the sea, is also the "Earthshaker," and devoutly feared.

For many years, geophysicists have attempted to describe the actual counterparts of these mythical animals and storms. At the same time, they have tried to relate these unseeable subterranean forces to their surface manifestations -- the building of mountains, the bending of ocean trenches, the tearing of seafloors, the apparent drifting of continents, volcanic eruptions, and earthquakes.

Figure 2.1 shows the planet Earth to consist of a thin crust two or three miles thick under the oceans and as much as 25 miles thick beneath the continents that covers the large, solid sphere of the rock mantle, which descends to about 1800 miles. Below the mantle is the outer core and at about 3200 miles depth the inner core. The province of earthquakes recorded thus far is from the crust to a maximum depth of about 450 miles.

Conditions thought to prevail in this high-pressure earthquake zone cannot be simulated in existing laboratories because at the base of the mantle the pressure is about 11,000 tons per square inch and the temperature is about 10,000 degrees Fahrenheit. These pressures produce a rigidity in mantle rock about four times that of ordinary steel, with an average density about that of titanium.

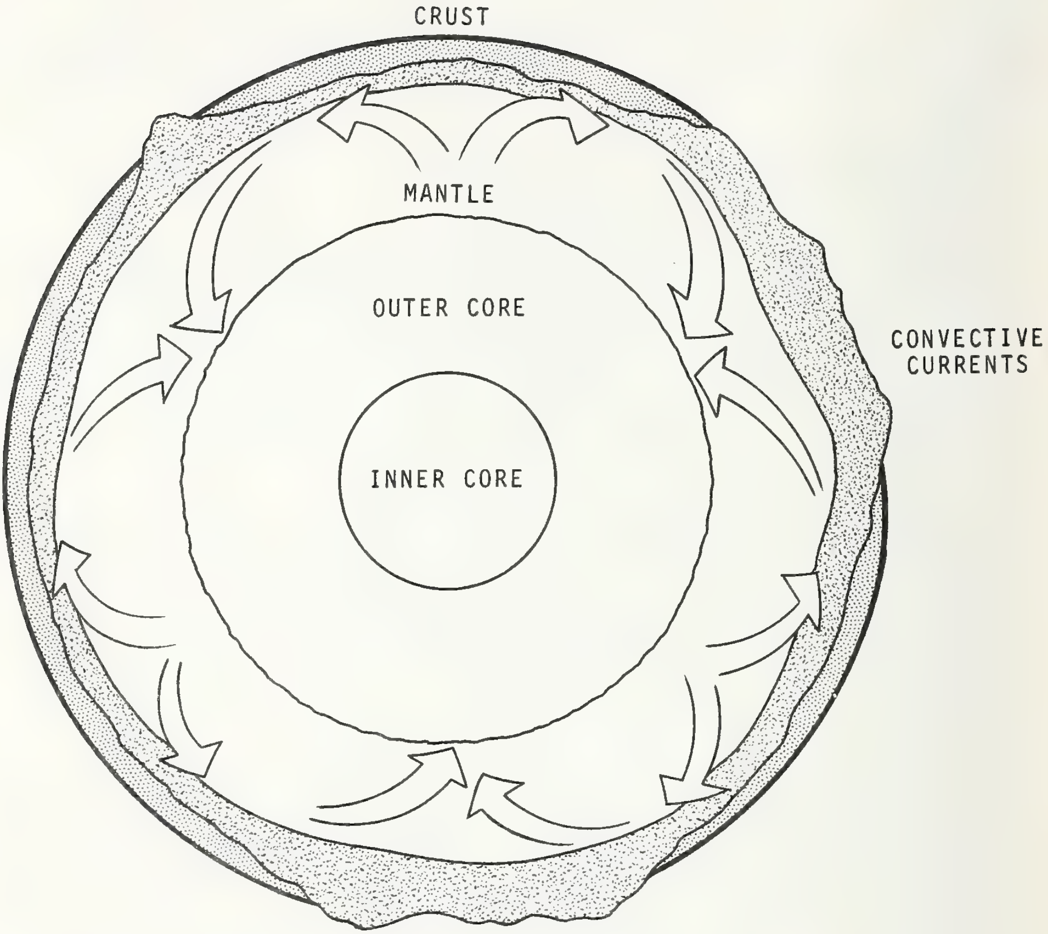


Figure 2.1 Fluid Currents in the Earth

The very solid mantle rock behaves over periods of millions of years, like a very sluggish fluid. The temperature difference between the white-hot region near the earth's core and the cooler region near the earth's crust drives slow-moving cycles of rising and descending currents in the mantle rock itself. These currents rise beneath the ocean floor, thrust up the mid-ocean ridges, and generate the stresses which produce spine-like transverse cracks and shallow earthquakes. This is currently believed to be the mechanism which causes material to well up through the crust, replacing and spreading the old seafloor, and pushing drifting continents apart. Where these currents begin their descent at the edges of the continents they produce massive folding in the form of trenches and mountain ranges. These regions are the sites of the deeper earthquakes and of most volcanism.

Stresses generated in the earth's crust and upper mantle by convective currents are stored and under normal circumstances the rocks deform plastically, releasing pent-up energy before it builds to catastrophic levels. However, when stresses accumulate too rapidly to be removed by plastic flow, some structural compensation is necessary. Large blocks of material are slowly forced into highly strained positions along faults and held in place by a supporting structure of stronger materials. Finally, the stresses cause the supporting rocks to rupture, thus triggering a fracture. The sides of the rebounding fault move horizontally with respect to one another (strike-slip), vertically (dip-slip), or in combinations of such motion.

Sometimes all the released energy goes out in one large wrench, followed by trains of smaller tremors, or aftershocks. Sometimes the fault shift is preceded by the small structural failures, and foreshocks are therefore detected.

The slip along a fault sends out four basic types of seismic waves. Two of these wave types travel through the earth and the other two types travel only at the surface of the earth. The two types of waves which travel through the earth are called P and S waves and the two which travel along the surface are called Love and Rayleigh waves.

The primary (P) wave is longitudinal and propagates through both liquids and solids, and is usually the first signal that an earthquake has occurred. The P wave is the swiftest seismic wave, its speed varying with the material through which it passes but the speed is usually less than 4 miles per second.

As the compressional phase of the P wave passes through the earth, particles are pushed together and displaced away from the disturbance. The rarefactional phase dilates the particles and displaces them toward the earthquake source. For an object imbedded in the ground, the result is a series of sharp pushes and pulls parallel to the wave path.

The secondary (S) wave is a transverse wave and it travels at approximately one-half the speed of the primary wave. With a period and amplitude of about 2 times the associated P waves, these shear waves displace particles at right angles to the direction of wave travel. The vertical component of this movement is somewhat dampened by the opposing force of gravity; but side-to-side shaking in the horizontal can be quite destructive. Where the motion is perceptible, the arrival of the S waves marks the beginning of a new series of shocks.

The two surface waves are called Love and Rayleigh waves. The period of these waves is much greater than the body waves (e.g., 30 or more seconds versus less than two seconds). Love waves are shear type waves in the horizontal direction whereas Rayleigh waves are elliptical vertical waves. The speed of these waves is about 2-3 miles per second with the Love being slightly faster than the Rayleigh.

There are two parameters which are commonly used to describe the "size" of an earthquake. One parameter called the Modified Mercalli Intensity is an indication of an earthquake's apparent severity at a specific location. The intensity is prescribed by experienced observers using an I to XII intensity scale, see table 2.1. The primary disadvantage of this scale is that it is subjective. The Richter Magnitude of an earthquake is a measure of the energy released by an earthquake. The magnitude is based upon measurements of ground acceleration amplitudes on standardized instruments. Earthquakes of magnitude 5 or greater, usually generate ground motions which are potentially damaging to structures. Since the Richter Magnitude is on a logarithmic scale an earthquake of magnitude 6 has thirty times more energy release than a magnitude 5 earthquake and an earthquake of magnitude 7 has one-thousand times more energy than a magnitude 5 earthquake.

Magnitude also provides an indication of earthquake energy release, which intensity does not. Written in terms of equivalent tons of TNT,[2.1].

$$\log_{10} W = -4.82 + 1.5M \qquad (2.2.1)$$

where

W = tons of TNT

M = Richter magnitude

Table 2.1 MODIFIED MERCALLI INTENSITY (MMI) SCALE

I. Not felt except under especially favorable circumstances.

II. Felt by persons at rest, on upper floors, or favorably placed.

III. Felt indoors. Hanging objects swing. Vibration like passing of light trucks. May not be recognized as an earthquake.

IV. Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt like a heavy ball striking the walls. Standing motor cars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. Wooden walls and frames creak.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move.

VI. Felt by all. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken visibly, or heard to rustle.

VII. Difficult to stand. Noticed by drivers of automobiles. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices, also unbraced parapets and architectural ornaments. Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged.

VIII. Steering of automobiles affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in floor or temperature of springs and wells. Cracks in wet ground and on steep slopes.

IX. General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. General damage to foundations. Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluviated area sand and mud ejected, earthquake foundations, and craters.

X. Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly.

XI. Rails bent greatly. Underground pipelines completely out of service.

XII. Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air.

<u>Definition of Masonry A,B,C,D</u>

<u>Masonry A</u>

Good workmanship, mortar and design; reinforced, especially laterally and bound together by using steel, concrete, etc.; designed to resist lateral forces.

<u>Masonry B</u>

Good Workmanship and mortar; reinforced but not designed in detail to resist lateral forces.

<u>Masonry C</u>

Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners but neither reinforced nor designed against horizontal forces.

<u>Masonry D</u>

Weak materials, such as adobe; poor mortar; low standards of workmanship, weak horizontally.

Table 2.2 shows the energy-released, felt area, distance felt and maximum expected MMI for various magnitude earthquakes.

Utilizing past earthquake history one can obtain a general feeling for the seismicity of various regions of the United States. Figure 2.2 shows a map of the Continental United States with historically recorded maximum Mercalli Intensities through 1965. Utilizing historical data of this type it is possible to create a macro-seismic risk map of the United States and such a map is presented in the Uniform Building Code [2.5] and is shown in figures 2.3 and 2.4.

The previous description of seismicity does not directly relate to the analysis or design process because it is not expressed in terms of a parameter appropriate for such use. Because the earthquake loading is a dynamic phenomenon, potential description parameters must be related to the amplitude, duration or frequency content of earth shaking. If the loading on a structure is to be treated as an equivalent static loading then the maximum site ground acceleration is found to be an acceptable description parameter. While most building codes approach the earthquake problem on this level, the specification of building site response spectra is more rational for building structures and can be considered to be state-of-the-practice. The actual mechanics of generating earthquake loads is described in detail in chapter 3; however, for the present discussion it is sufficient to state that the characterization of such spectrum requires a knowledge of maximum earthquake induced acceleration or velocity. Therefore, it is logical to characterize the seismicity of a region by its maximum expected acceleration or velocity.

One approach to the characterization of the potential earthquake distructiveness of a particular region involves the specification of the maximum earthquake accelerations. Figure 2.5 shows a map for the State of California which indicates one expert's opinion of the maximum ground motion which can be expected [2.6]. These estimates are meant to be conservative and to represent upper bounds.

An alternate approach is the specification of maximum expected earthquake accelerations corresponding to a particular structural life. Such an approach is based on probabilistic concepts and enables the earthquake engineer to select a maximum acceleration based upon an acceptable level of risk for the conditions of service, the life of the structure which is to be designed and also upon his own view of acceptable level of risk.

Table 2.2 EARTHQUAKE MAGNITUDE AND INTENSITY

Magnitude (Richter)	Energy-Released (Tons of TNT) [2.3]	Felt Area (square miles) [2.4]	Distance Felt (miles) [2.2]	Level of Expected Modified Mercalli [2.3]
3.0 - 3.9	0.48 - 15.2	750	15	II - III
4.0 - 4.9	15.2 - 480	3,000	30	IV - V
5.0 - 5.9	480 - 15,000	15,000	70	VI - VII
6.0 - 6.9	15,000 - 480,000	50,000	125	VII- VIII
7.0 - 7.9	480,000 - 15,000,000	200,000	250	IX - X
8.0 - 8.9	15,000,000 -480,000,000	800,000	450	XI - XII

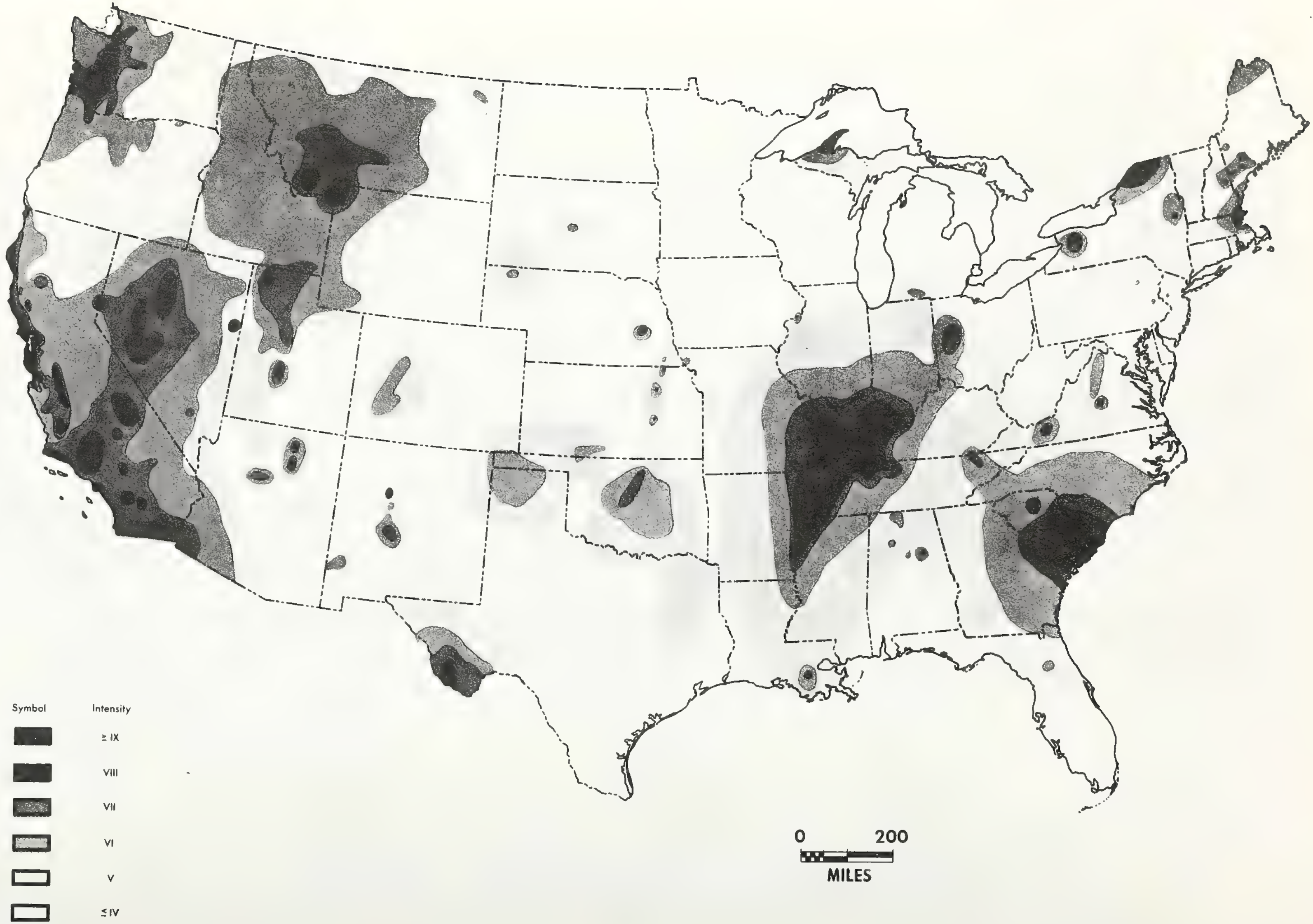
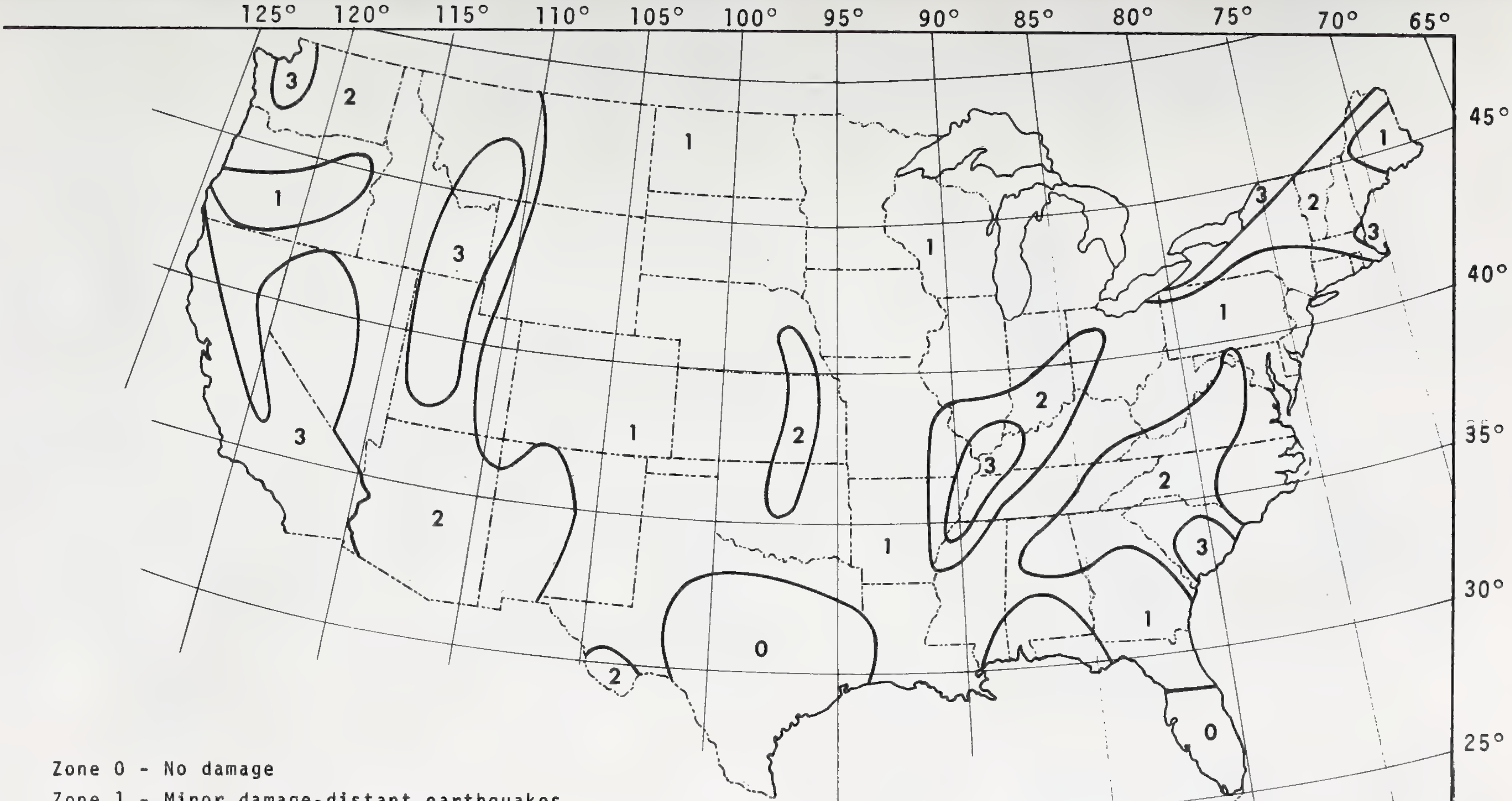


Figure 2.2 Maximum Modified Mercalli Intensities Through 1965



Zone 0 - No damage

Zone 1 - Minor damage-distant earthquakes may cause damage to structures with fundamental periods greater than 10 seconds-corresponds to intensities V and VI of the MM* Scale

Zone 2 - Moderate damage-corresponds to intensity VII of the MM Scale

Zone 3 - Major damage-corresponds to intensity VIII and higher of the MM Scale

This map is based on the known distribution of damaging earthquakes and the MM intensities associated with these earthquakes evidence of strain release, and consideration of major geologic structures and provinces believed to be associated with earthquake activity. The probable frequency of occurrence of damaging earthquakes in each zone was not considered in assigning ratings to the various zones.

*Modified Mercalli Intensity Scale of 1931

Figure 2.3 Seismic Risk Map of United States

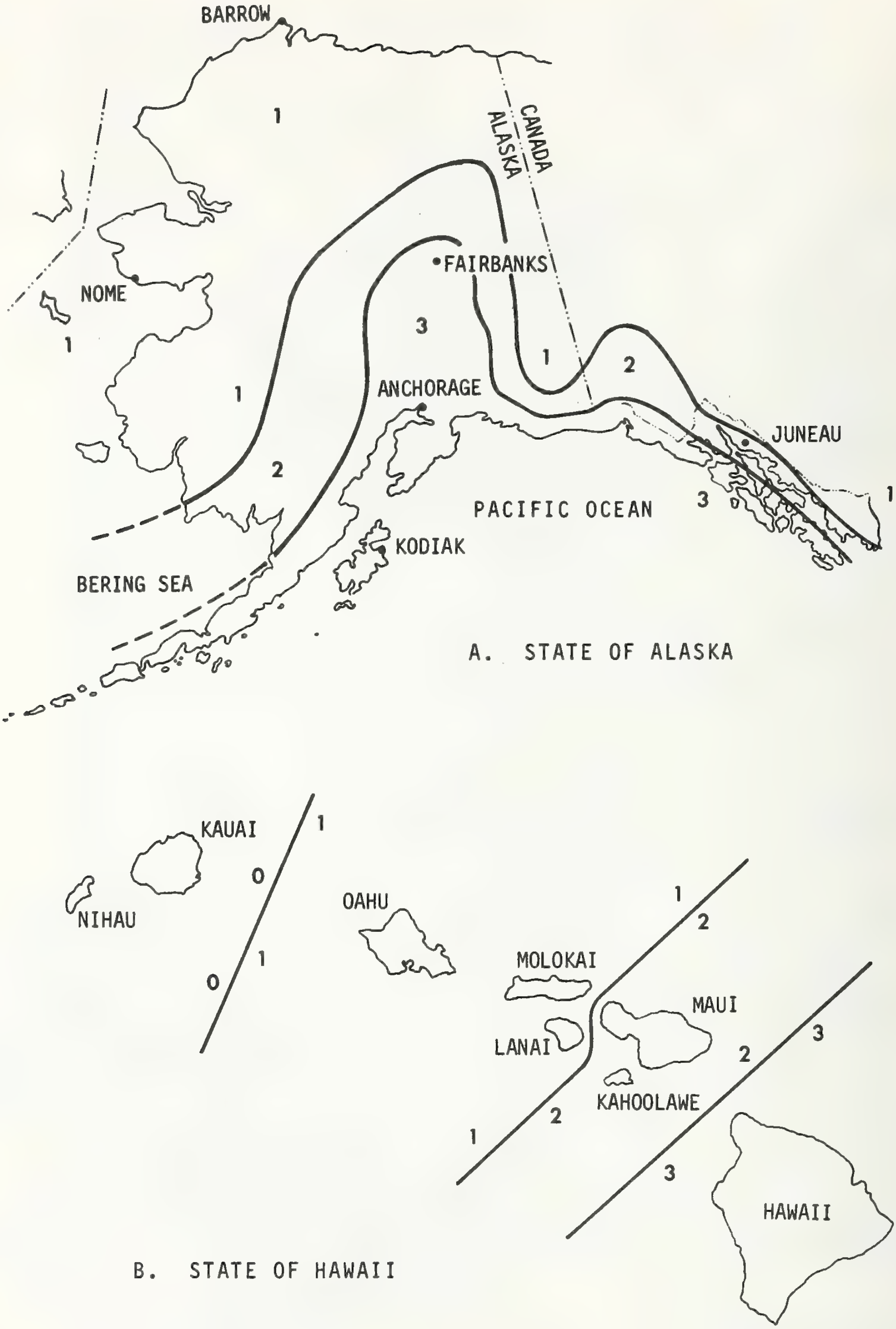
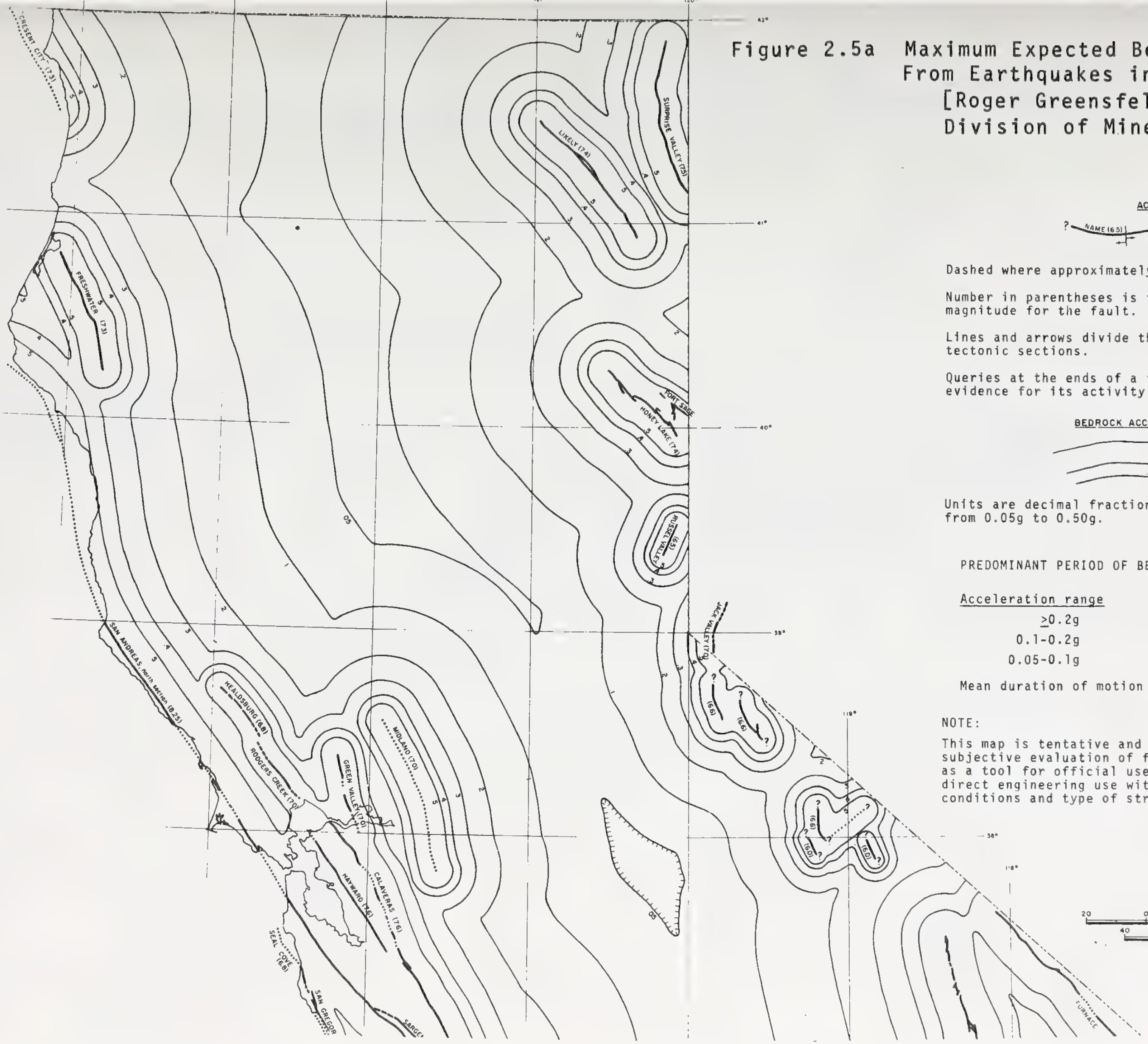


Figure 2.4 Seismic Risk Map of United States

Figure 2.5a Maximum Expected Bedrock Accelerations From Earthquakes in California [Roger Greensfelder-California Division of Mines and Geology, 1972]



LEGEND

ACTIVE FAULTS

Dashed where approximately located; dotted where concealed.

Number in parentheses is the maximum expected earthquake magnitude for the fault.

Lines and arrows divide the San Andreas fault into four tectonic sections.

Queries at the ends of a fault indicate lack of strong evidence for its activity.

BEDROCK ACCELERATION CONTOURS

Units are decimal fractions of the acceleration of gravity, from 0.05g to 0.50g.

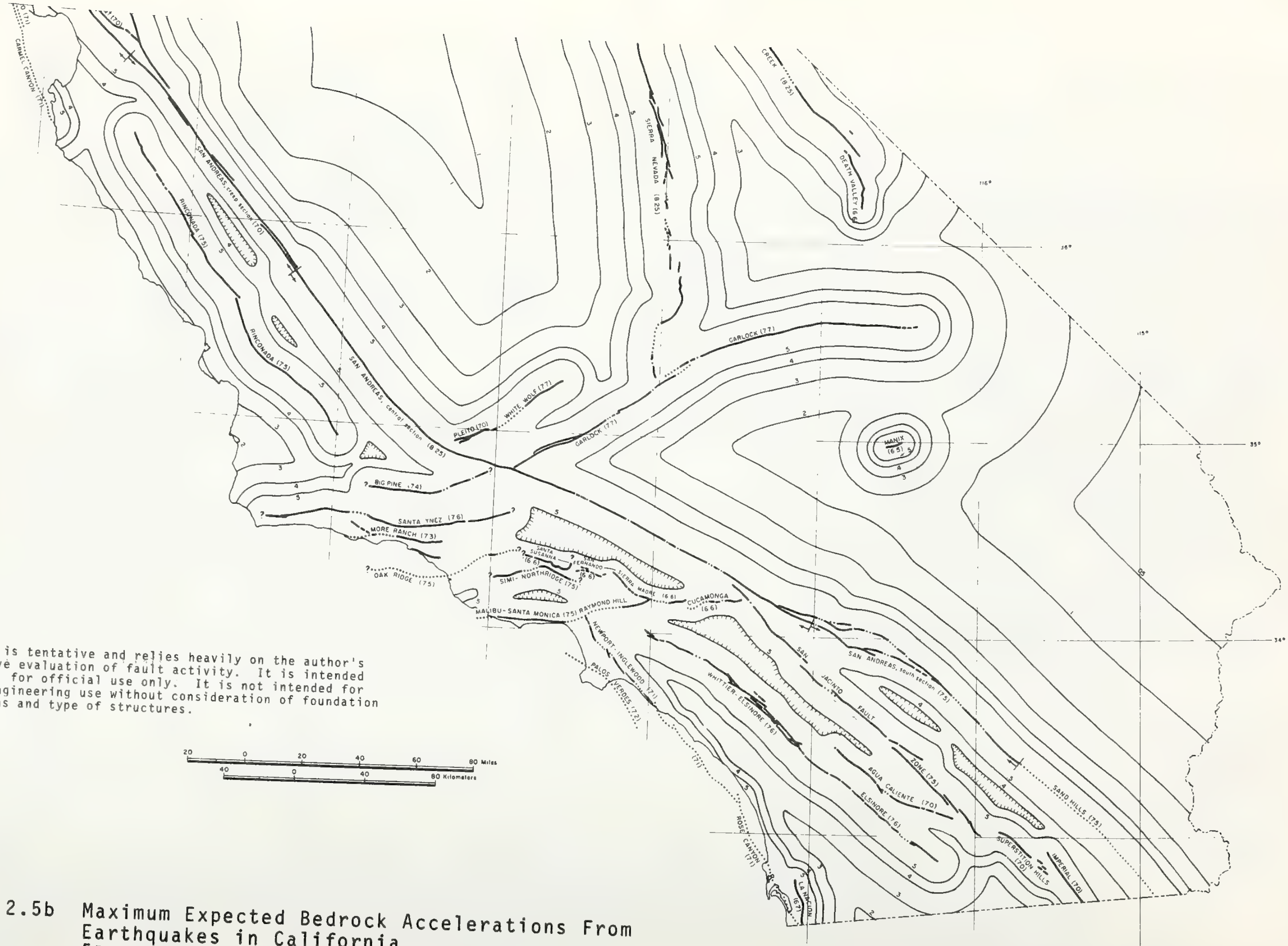
PREDOMINANT PERIOD OF BEDROCK ACCELERATIONS

Acceleration range	Predominant period
≥0.2g	0.35 seconds
0.1-0.2g	0.40 seconds
0.05-0.1g	0.50 seconds

Mean duration of motion 20-30 seconds

NOTE:

This map is tentative and relies heavily on the author's subjective evaluation of fault activity. It is intended as a tool for official use only. It is not intended for direct engineering use without consideration of foundation conditions and type of structures.



NOTE:

This map is tentative and relies heavily on the author's subjective evaluation of fault activity. It is intended as a tool for official use only. It is not intended for direct engineering use without consideration of foundation conditions and type of structures.

Figure 2.5b Maximum Expected Bedrock Accelerations From Earthquakes in California [Roger Greensfelder-California Division of Mines and Geology, 1972]

Figure 2.6 shows one such map for the southern California area [2.7]. The methodology presented in section 3.4 of this report can alternatively be used to create seismic zoning maps. At the present time, such maps do not exist; however, the maximum hardrock velocities for several United States cities are shown in table 2.3. These maximum velocities are based upon earthquakes of a 100 year return period.

The preceding methods of characterizing seismic activity are often called macro-seismicity characterizations because they characterize large geographic region. Micro-seismic characterization is an improvement upon macro-seismic characterization in the sense that it attempts to characterize the seismicity of a smaller, or more local, region. Because of governmental considerations, micro-seismic characterization (often called micro-zoning or seismic element zoning) is most commonly done for city or county governments. In such a study, the local soil conditions and the location of local earthquake faults can be studied in more detail and more accurately incorporated into the seismicity characterization. The descriptive parameter for the micro-seismicity study can still be either deterministic (i.e., specifying the maximum possible ground acceleration) or probabilistic (i.e., specifying the maximum acceleration based upon structural life and acceptable level of risk). As an example of such a micro-seismic characterization, figure 2.7 shows a micro-seismic zoning map for the City of Long Beach, California [1.1].

The loads on a structure generated by an earthquake can result from ten basic mechanisms:

1. Shaking the structure
2. Shaking the ground beneath the structure, causing settlement
3. Shaking the ground beneath the structure, causing foundation failure
4. Ground lurching
5. Ground liquefaction
6. Earth surface faulting
7. Slope failure into or beneath structure
8. Tsunami water wave
9. Seiche water wave
10. Dam failure and resulting water surge loads.

This study deals with only loading mechanism No. 1 since the greatest percentage of expected earthquake damage results from this failure mechanism.

B. Wind Loading Considerations

The wind load exerted on a structure from non-tornado and hurricane con-

ditions is a very significant design factor. A building must be designed for loads resulting from severe winds and often, from a design point of view, it is these wind loads and not the earthquake loads which govern the design.

Figure 2.3 showed a seismic risk map for the United States as presented in the Uniform Building Code [2.5]. This map characterized in a general way the historical seismic activity of the United States. Figure 2.8 shows a relative characterization of wind loading over the United States as presented in the Uniform Building Code. Section 3.4 of this report presents a more detailed discussion of the loading problem. However, at this point it is important to recognize, that wind loads are regionally dependent. In fact, the same macro- and micro-regional concepts which have been alluded to for seismic characterization apply to wind characterization where the local geographical conditions strongly influence the local wind environment at a site.

C. Tornado Loading Considerations

A tornado is a violently revolving column of air. A funnel is caused by violent convection from intense sun heating of the ground, aided by opposing winds of greatly differing temperatures. The tornado develops below a heavy cumulo-nimbus cloud mass. The funnel may reach the ground where it is then dragged by friction. The tornado dies out in the reverse direction. Rotation of the funnel may be either clockwise or counterclockwise. The diameter of the funnel is usually around 1,000 feet, although there may be considerable variation. Because of the rotating character of the funnel there exist high wind speeds at the eye of the tornado (ranging up to about 300 miles per hour) and, because of centrifugal effects, the barometric pressure at the eye is very low. An updraft of wind at the center of the tornado may have wind speeds up to 200 miles per hour.

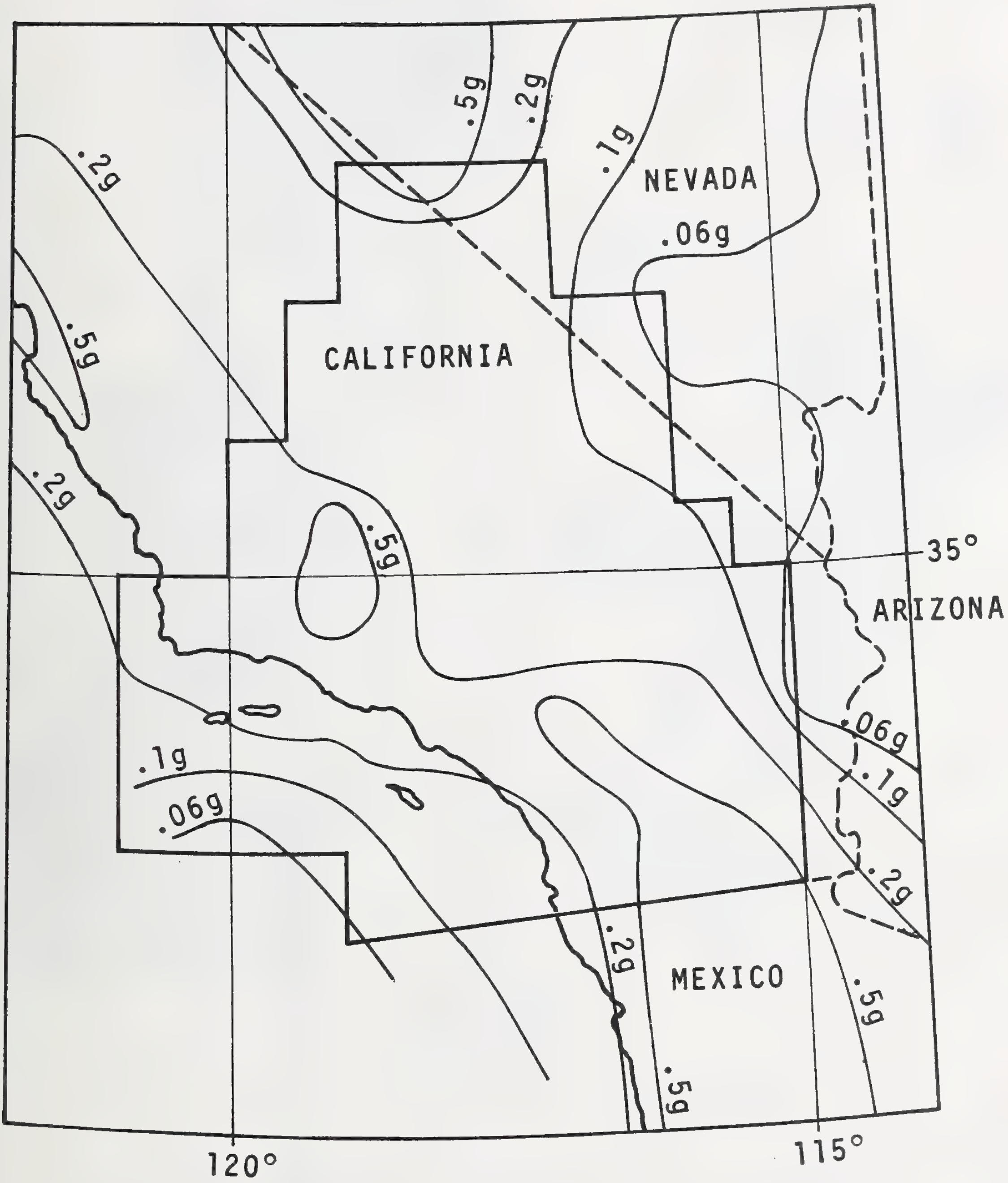


Figure 2.6 Accelerations With a 100-Year Return Period (From Milne and Davenport[2.7])

Table 2.3 MAXIMUM HARDROCK VELOCITIES FOR EARTHQUAKES OF 100 YEAR RETURN PERIOD

STATE: CITY	MAXIMUM HARDROCK VELOCITY (inches/second)
Alaska : Anchorage	2.608
Arizona : Phoenix	0.213
Arkansas : Little Rock	0.855
California : Los Angeles	4.656
: Sacramento	1.001
: San Diego	1.112
: San Francisco	7.101
Georgia : Atlanta	0.354
Hawaii : Honolulu	0.203
: Hilo	1.760
Idaho : Idaho Falls	0.511
Illinois : Chicago	0.575
Indiana : Indianapolis	0.556
Kansas : Wichita	0.239
Kentucky : Louisville	1.080
Massachusetts : Boston	0.562
Missouri : St. Louis	1.778
Montana : Helena	5.849
Nebraska : Omaha	0.226
Nevada : Las Vegas	2.356
: Reno	1.930
New Mexico : Albuquerque	1.174
New York : New York	0.910
Ohio : Cincinnati	0.565
Oklahoma: Oklahoma City	0.486
Oregon : Eugene	1.551
: Portland	1.702
Pennsylvania : Pittsburgh	0.298
South Carolina : Columbia	0.391
Tennessee : Memphis	1.979
Utah : Salt Lake City	2.616
Washington : Seattle	1.801
Washington, D.C.	0.347

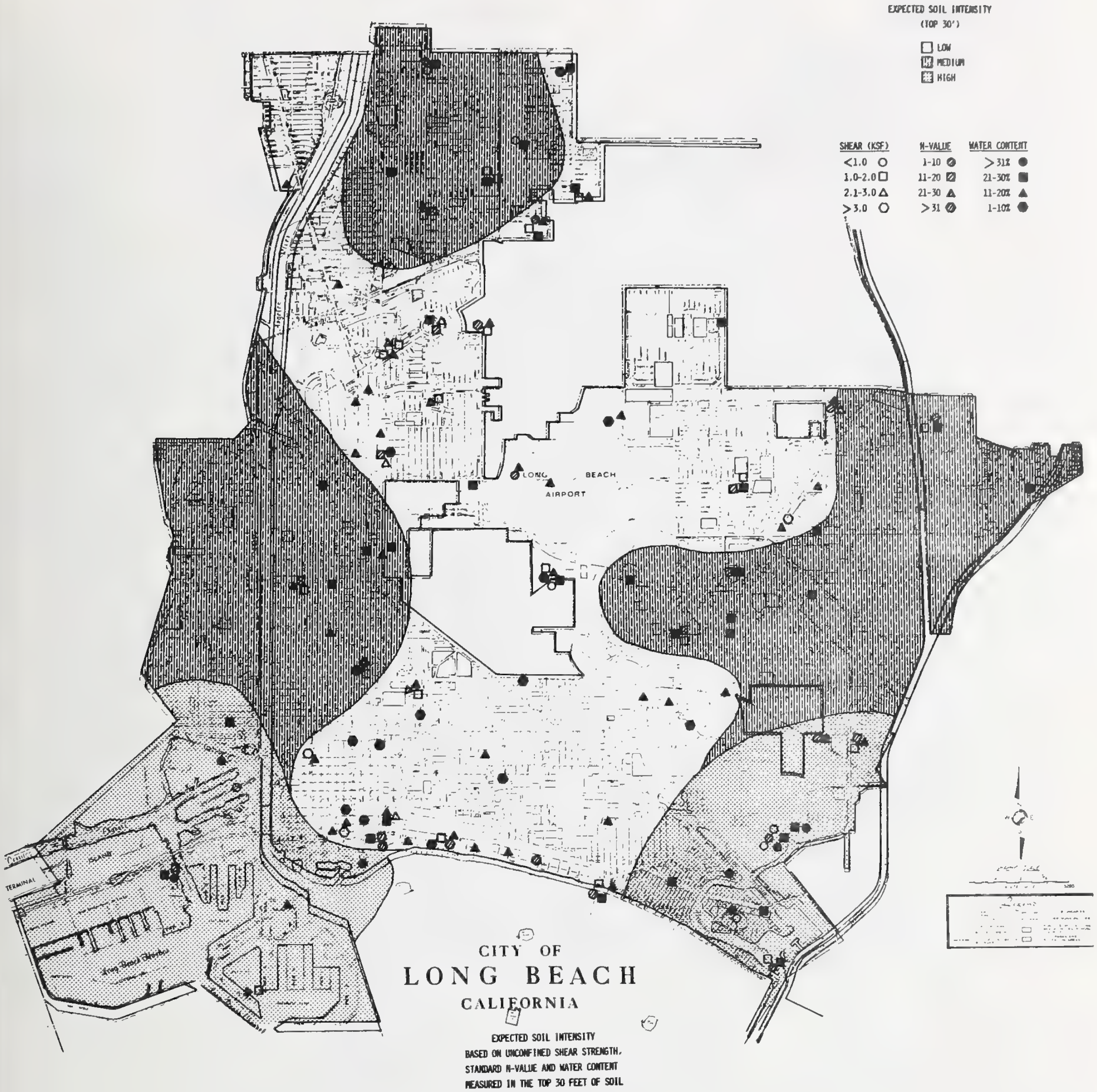


Figure 2.7 Micro-zoning Map for the City of Long Beach, California

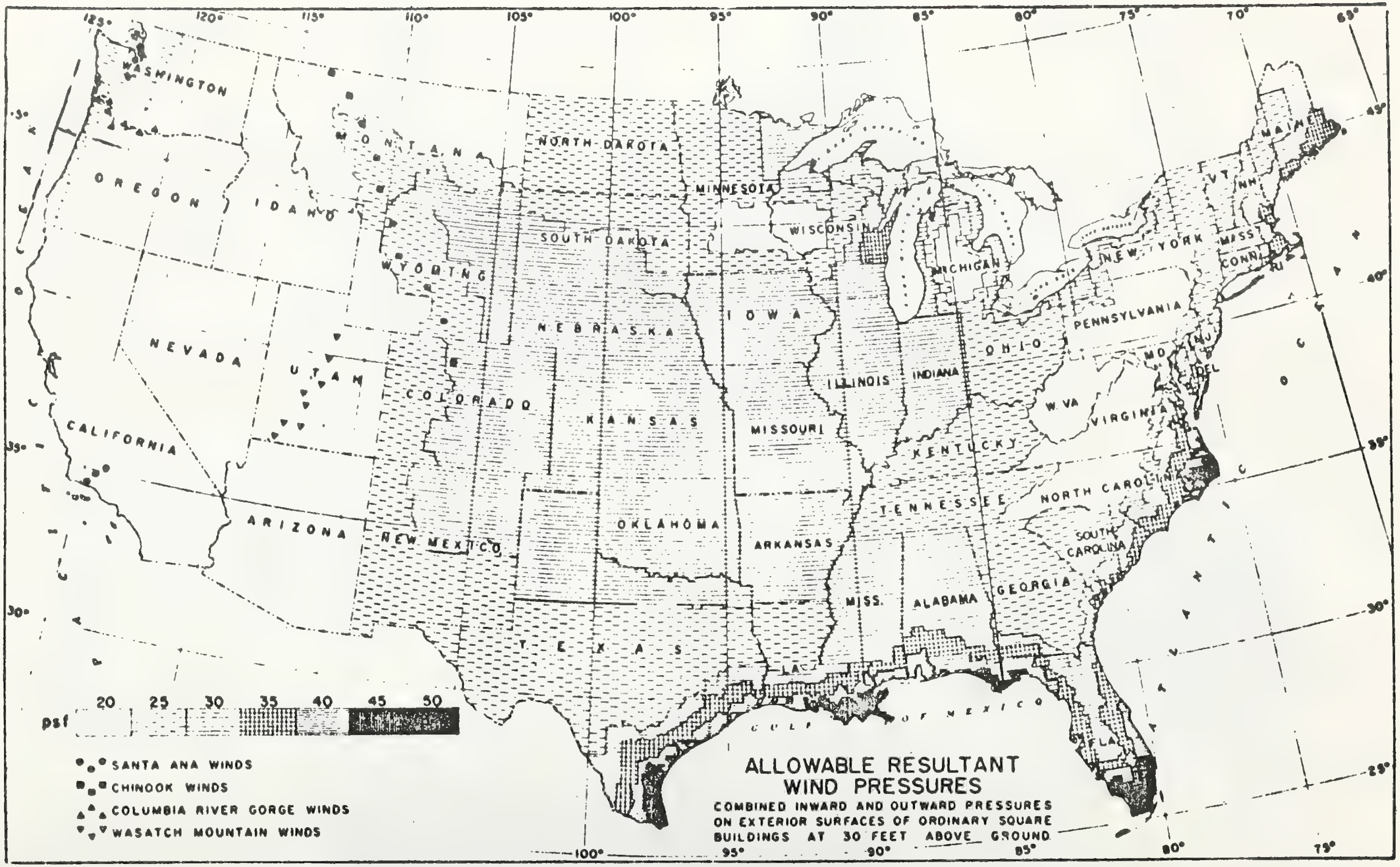


Figure 2.8 Regional Variation of Wind Loads

Most United States tornadoes occur east of the Rocky Mountains in the eastern region of the Great Plains--from Iowa to Texas. Figure 2.9 shows a map of the United States summarizing the mean annual frequency of tornado occurrences. Paths of tornadoes are usually short, ranging from several miles to a few hundred miles and they travel from southwest to northeast at speeds ranging from 10-50 miles per hour. Tornadoes are most often formed in association with thunderstorms, and therefore, accompanying hail or rain is common.

Since a tornado is a violent disturbance involving high wind speeds, the common approach for the design of buildings is the specification of a design wind velocity. This velocity is used to calculate loading on the structure using experimental and/or analytical wind velocity-wind pressure relationship. The dynamic character of the wind pressures on the structure, as well as the structure itself, are usually incorporated into the design process by using a gust factor. This factor multiplies the predicted static wind pressures which, when used in response calculations, will be approximate but acceptable for engineering purposes.

D. Hurricane Loading Considerations

A hurricane is a tropical storm, originally applied to storms in the West Indies only, but a term now applied to this type of storm in other parts of the world. The name is derived from the word "hurracan" of the Arawak-speaking Indians of the West Indies.

In the eastern United States the hurricane season lasts roughly from June to October. In midseason, August and September, hurricanes develop mainly near or to the east of the Lesser Antilles. Early and late in the season, in June and from the latter part of September onward, the area with most frequent formation is the western Caribbean. The Gulf of Mexico also is a breeding ground for hurricanes, as is the Pacific just off the Central American coast, see figure 2.10.

After formation, most hurricanes move northwest, gradually turning more directly north as they move out of the tropics. The United States intercepts all hurricanes moving northward in the Gulf, and since the land mass extends further east with increasing latitude, it also intercepts many hurricanes moving northward on the ocean side of Florida. Some of the most extensive damage suffered from hurricanes has been sustained in New England. This damage has resulted partly from the wind, especially the effects of wind upon the sea near coasts, but also from floods following heavy rains in the mountainous sections of New England.

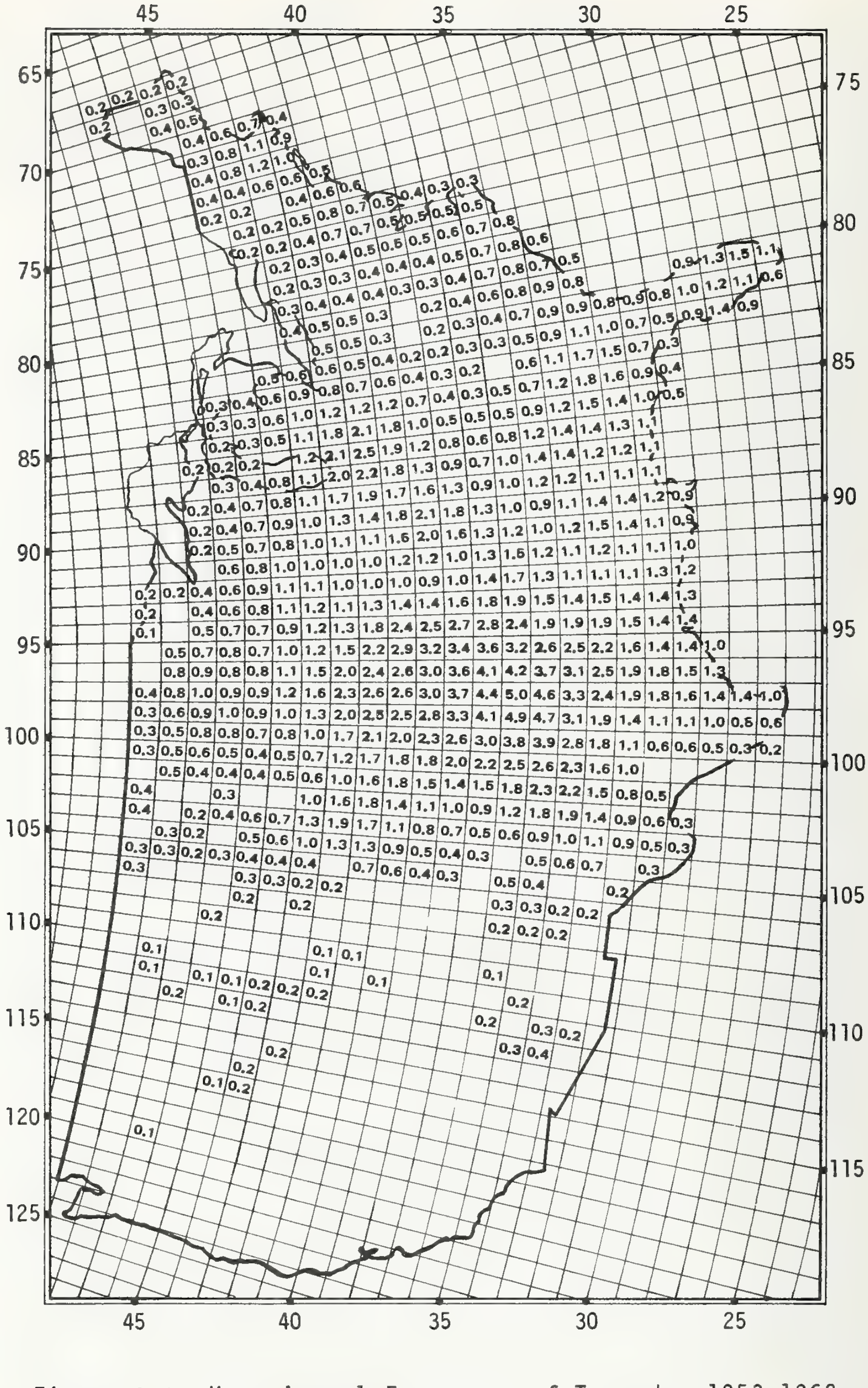


Figure 2.9 Mean Annual Frequency of Tornados 1953-1962

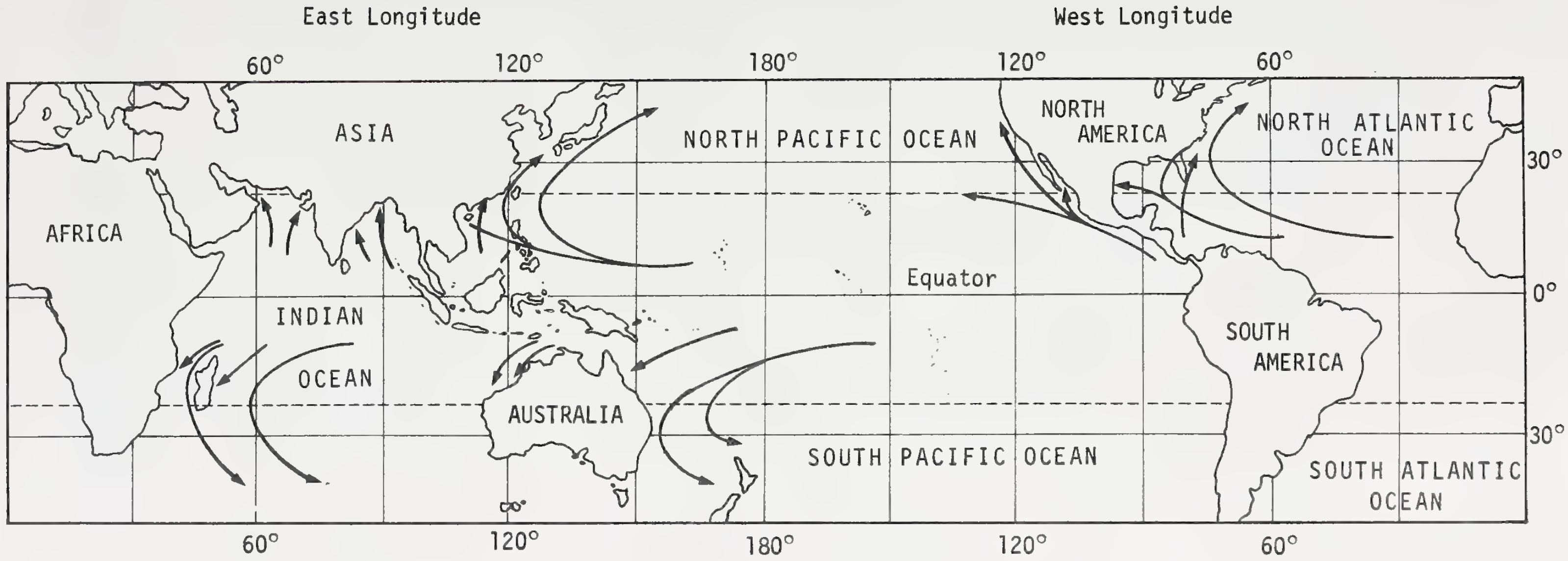


Figure 2.10 Paths Taken by Hurricanes

Hurricanes result from convective heating. The moist, warmed air at the water's surface, being lighter than its environment, is forced up and replaced by the cooler, denser, surrounding air which blows spirally inward around the center or "eye" (see figure 2.11). The rotation is counter-clockwise.

The speed of travel of the hurricane ranges from 10 to 30 miles per hour and its diameter, when matured, varies from 25 to 500 miles. Like a tornado, the barometric pressure in the "eye" is low. Heavy precipitation and high wind speeds (i.e., greater than 75 miles per hour) accompany hurricanes.

The loads on buildings resulting from hurricanes are, like tornadoes, assumed to be related to wind velocities. Mean wind velocities and resulting wind induced building pressures are amplified to take into account the dynamic characteristics of the winds and the building. A gust factor is used for this amplification.

2.3 STRUCTURAL CHARACTERIZATION

The continuous evolution of analytical and experimental structural engineering enables the engineer to continuously improve upon his analytical representation of reality. Increased application of the computer in recent years has enabled the engineer to use a more detailed analytical model of a building. However, in the final analysis the choice of an analytical model continues to primarily depend upon the following three factors: (1) the type of loading -- static or dynamic, (2) the desired response parameters, and (3) the geometric and structural layout of the building.

If the loading acting on a building is static then only the building's stiffness characteristics need be modeled. The analytical building model may be detailed or gross. Models of the former type usually involve matrix methods wherein the stiffness characteristics of each building member are represented using a member stiffness matrix. These elemental stiffness matrices are then combined to form the complete building stiffness matrix. The model resulting from this approach is often referred to as a finite element model. At the other extreme, building models of the latter type represent all structural members at a particular floor with one interstory stiffness element. The detailed building model is usually used when the engineer is concerned with estimating the stresses in the structural members whereas the gross model is used to obtain general estimates of building floor displacements.

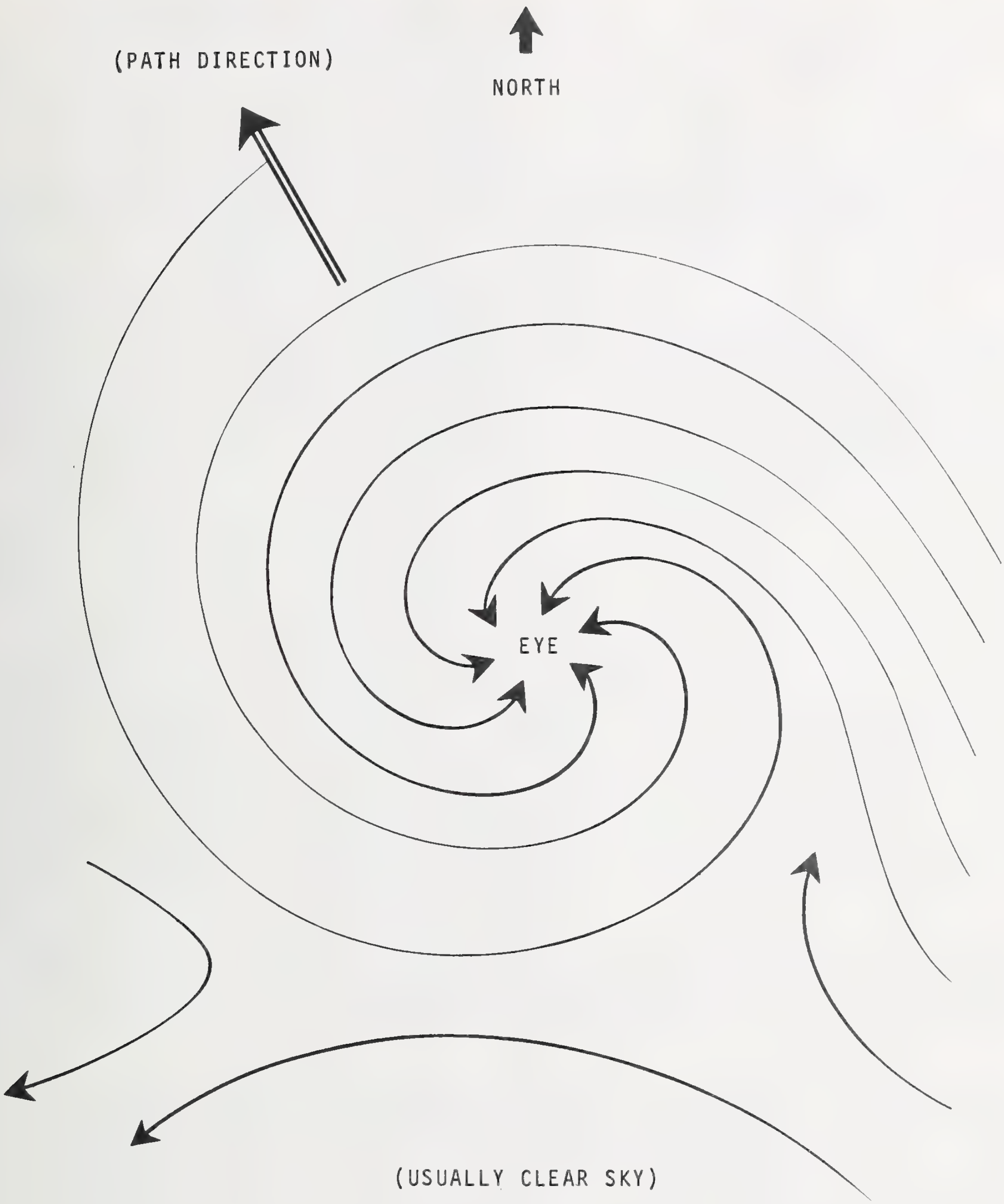


Figure 2.11 Wind Flow Patterns Around Eye of Hurricane

Dynamic loads acting on the building introduce the additional variable of building mass. Modeling is usually accomplished by lumping at the floor level the dead weight of the floor slabs plus the tributary weight of all columns, window walls and partitions. This model is used in almost all building studies even though analytical techniques do exist for rationally representing the mass properties of all structural components. The lumped mass model is used because it enables one to write more efficient computer programs and because the error introduced by such a model seems to be acceptable in light of other uncertainties in the response problem.

Recognizing that the hazards considered herein induce lateral loading, it is important in analyzing the structure to clearly distinguish between the vertical load resisting elements and lateral or horizontal load resisting elements. The considerations involved are discussed in detail in Chapter 3.

Two structural characterization considerations which are attracting considerable earthquake engineering research effort at the present time are (1) soil structure interaction and (2) torsional building response. The soil structure interaction problem is discussed in reference [2.8]. At the present time there exist two general areas of discussion and research. The first involves modeling of the subsurface soil-building system. Finite element techniques exist for modeling building foundations with irregular geometric shapes and arbitrary soil strata. However, these methods do not prove completely adequate in the representation of the far field boundary conditions. Continuum mechanics solutions can very nicely model the radiation damping aspects of the problem but prove to be inadequate for arbitrary irregular basement and common boundary conditions. While it may be possible to reconcile a common soil-structural interaction approach, any such attempt at this time seems premature because to date the amount of available full scale information from past earthquake experience is not sufficient to prove or disprove any of several commonly accepted approaches.

The torsional response of buildings during earthquake and wind excitation has been observed [2.9]. This torsional response results from two sources. First, if a building has an irregular floor plan such that the building center of mass and center of stiffness do not coincide then translation loading components will produce torsional floor response. Moreover, since little is known about the damping present in torsional modes of vibration it may also be that even for symmetric buildings differences in damping values for the various modes may produce torsional floor motions. The second source of torsional response is the loading itself. This loading takes the form of a twisting component of ground motion [2.9] for the earthquake problem and a floor story torque for wind forces. While analytical modeling

techniques exist for representing the three dimensional stiffness and mass characteristics of a structure, further research remains to be done using full scale test results before the loading and modal damping coupling can be adequately characterized.

At the present time, a consensus does not exist regarding the manner in which these effects should be accounted for in design. Neither effect, therefore, was included in the methodology presented herein. An approximate procedure for considering the forces resulting from the torsional moment associated with buildings having an irregular floor plan has been included in the Approximate Analytical Evaluation Method (Section 3.3 page 3-36). It is reasonable, to expect, however, that it will only be a short time, perhaps 5 to 10 years, before a consensus of opinion can be reached on how these factors can be incorporated in design and damage evaluation. It would then follow that their inclusion in the methodology presented would become appropriate.

2.4 BUILDING RESPONSE ANALYSES

The response of the building is obtained using either a static or a dynamic analysis. A static response analysis is common in wind, tornado, and hurricane problems wherein the dynamic character of the response is usually incorporated via a gust factor. This gust factor is usually dependent upon such dynamic parameters as fundamental building period and damping. This factor multiplies mean static loads to obtain a design loading for static analysis. In earthquake response studies a static response analysis is used when one uses the procedures recommended by most codes.

A nonlinear static analysis is possible with existing analytical technology; however, due to the uncertainties in the building and loading parameters, it is not commonly utilized in practice.

There are two basic choices available to the engineer when using a linearly elastic dynamic analysis procedure. One choice is hereafter referred to as the Modal Analysis Method and the other is referred to as the Direct Integration Method.

Either static or dynamic analyses may be used in connection with the evaluation procedures described in Chapter 3.

The modal analysis method involves the calculation of the natural periods and mode shapes of vibration of the building. These dynamic response parameters enable the engineer to mathematically define a set of distributed coordinates which characterize the deformed shape of the building. These distributed coordinates are usually referred to as normal mode coordinates and experience indicates that whereas many hundreds or perhaps thousands of physically identifiable discrete coordinates at the junctions of beams and columns may be necessary to specify the deformed shape of the building a significantly smaller number of distributed coordinates can be used to define the approximate deformed shape of the building within acceptable engineering accuracy. Mathematically, the discrete coordinates are obtained using a matrix transformation of the normal coordinates.

The primary motivation for using distributed normal mode coordinates in building dynamics is that when cast in this way, the dynamical equations of motion for the building are uncoupled second order differential equations identical in form to the equations of motion obtained for a simple single degree of freedom oscillator. Therefore, the building's dynamic response is expressed as the summation of a weighted series of single degree of freedom oscillator responses. Moreover, physically understood terms that are appropriate for single degree of freedom system description (e.g., natural period of vibration and percent critical damping), are also description parameters for the building problem. This extension of single degree of freedom concepts to the solution of a complex building's response enables the engineer to retain a physical feeling for the problem (i.e, engineering insight) and it is this factor that primarily accounts for the wide usage of the mode analysis method. Parenthetically, it is noted that this engineering insight enables an engineer to verify at intermediate steps in the solution process the numbers generated by the computer program and therefore, he can have more confidence in the accuracy of the computer generated answers.

The modal analysis method offers the engineer two analysis options - a response spectrum or a time history solution. A response spectra solution in the earthquake problem requires as input the response spectra of building base motion. The time history input requires an acceleration versus time history of base motion.

The direct integration method involves a straightforward numerical solution of the matrix dynamic equation of motion at each instant in time. In this method the building's natural periods and mode shapes of vibration are not calculated.

While modal damping must be specified in the modal analysis method, the direct integration method requires the specification of a complete system damping matrix. In practice the latter is usually estimated from test data using modal response.

The calculation of the nonlinear dynamic response of a building can be accomplished in a straight forward manner using step-by-step solution techniques as has been demonstrated by many authors. However, at the present time there appears to be two significant drawbacks to the widespread application of such nonlinear response algorithms. First, dynamic tests on full-scale structural components have not been numerous and there exists considerable uncertainty in the dynamic behavior of actual building components under earthquake type excitations. One can expect significant advances in this area in the next few years. Second, the financial expense of performing a nonlinear dynamic analysis on buildings can be great. Unless the building under consideration is a special structure for which a significant amount of money is allocated for a dynamic analysis, the engineer cannot afford to perform such an analysis.

2.5 NATURAL HAZARD DAMAGE EXPERIENCE

It is expected that buildings will experience damage when they are subjected to extreme natural forces such as those resulting from earthquakes, hurricanes, and tornadoes. There are exceptional cases in which buildings should not sustain damage such as nuclear reactor facilities. Damage to such buildings are not considered herein. In this section types of damage observed in past natural disasters which are most likely to occur are presented.

There is a fundamental difference in the way in which lateral loads are transmitted to a building from earthquake and from wind. In the case of earthquake, the load is transmitted to the building from its base. Thus, the entire building as well as the building contents will experience the force. In general, the magnitude of this force which individual members experience is proportional to their mass. On the other hand, in the case of wind, the load is transmitted to the building through its envelope. Thus, the cladding and its supporting members experience the initial effects of the wind load. Except for the structural members, the interior of the building including its contents will not experience the wind loads directly as long as the envelope remains intact. Therefore, the damage a building will sustain from these two natural events is different. In the remainder of this section, damage resulting from earthquake and wind is discussed separately.

Building Damage due to Earthquake

Current building codes anticipate that damage will occur to buildings when subjected to severe earthquakes. While not specified in the main body of the code, the intent of the seismic provisions in the present codes are to provide adequate resistance so that:

1. No damage would be sustained by the building in minor earthquakes,
2. No structural damage, but minor nonstructural damage would be sustained by the building in moderate earthquakes,
3. Structural damage as well as nonstructural damage would be sustained by the building without collapse in severe earthquakes.

Since a moderate earthquake is considered to be about a Richter magnitude of 4.0, any earthquake greater than this level would be expected to cause damage. The extent of damage, in general, is dependent on the building's dynamic characteristics, strength, durability, and stiffness. Damage experience in the past has shown that buildings deficient in any one of these have suffered severely. In addition, nonsymmetrical disposition of lateral load resisting systems could lead to an unfavorable response of the building, thereby inducing severe damage. Nonstructural elements not securely attached to structural members also suffer damage when the building is shaken by earthquakes. The extent of damage to these elements is dependent on the type of connections and their strength and stiffness.

Moment-resisting unbraced frame structures are relatively more flexible than braced frame and shear-wall structures. Adequately designed structural members can undergo the resulting large deformations without severe damage. Nonstructural elements and the building contents may however suffer significant damage. Braced frame structures and shear-wall structures, on the other hand, are relatively stiff and less ductile than moment-resisting unbraced frame structures. If not adequately designed, these buildings can fail in a non-ductile manner. Because of their smaller interstory drift these structures may suffer less nonstructural damage.

The types of damage discussed above were well documented for the 1972 Managua earthquake. The Banco Central Building, a moment resisting unbraced frame structure, experienced very extensive nonstructural damage, while it suffered moderately severe damage to structural members. On the other hand, the Banco de American building, a shear wall structure, suffered extensive structural damage to shear girders which are a part of shear core providing the main resistance to lateral forces. This building being relatively stiff,

however, suffered little damage to the nonstructural elements and its contents. Detailed discussions of the performance of these two buildings are given in reference 2.10.

In general, structural members in moment resisting frames that suffer significant damage are columns and the panel zone at beam-column joints. Most of the column damage occurs at the ends. In the case of concrete frame structures, crushing of concrete with buckling of reinforcing bars and diagonal tension cracks, are usual modes of failure (fig. 2.12). For steel frame structures, local buckling of columns is a usual mode of failure (fig. 2.13). Panel zone failures in concrete and steel frames in a past earthquake are shown in figures 2.14 and 2.15.

Shear wall structures tend to fail in a non-ductile manner. Columns, piers, and floors and roofs acting as diaphragms tend to be severely damaged. Cracks formed in these members are illustrated in figures 2.16, 2.17, and 2.18. Failure of concrete floor diaphragm under high shear force is shown in figure 2.19.

Bearing wall structures are also relatively stiff. In order for this type of structure to survive an earthquake, the walls must remain intact in the vertical position. Many unreinforced or inadequately reinforced masonry bearing walls have generally sustained severe damage. Total collapse of such masonry structures is not uncommon. A typical old masonry infilled concrete frame structure near collapse is shown in figure 2.20. A severely damaged masonry bearing wall is shown in figure 2.21.

In shear-wall or load-bearing structures, lintels and shear beams that link shear walls sustain severe damage when not adequately designed. An example of such a failure is shown in figure 2.22.

Since the damage to structural and nonstructural members is due to the lateral motion of the building during an earthquake, the magnitude of the resulting inter-story drift can be related to the level of damage a building might sustain. The inter-story drift is incorporated in the development of the damage evaluation methods presented in this report and is used as an index in determining the level of damage.

Damage to buildings may result from non-uniform distribution of stiffness in plan and discontinuity of stiffness of the building along its height. These cause torsional deformations in addition to the flexural deformations resulting from the earthquake motions. Structures falling in this category are those buildings having irregular shapes and large differences in stiffness between stories. When a relatively stiff portion of a structure is supported by a flexible lateral load resisting system, the structure responds to ground shaking like an inverted pendulum and the flexible portion sustains the most damage. This type of failure was observed in the 1971 San Fernando earthquake and is shown in figures 2.23, 2.24, and 2.25.

Nonstructural elements can significantly alter the expected performance of the structure. In the Venezuela earthquake of 1967, many failures of concrete frame structures were attributed to the unexpected forces produced in frame members resulting from partitions acting as stiff shear walls. Detailed discussions of structural failures resulting from this type behavior are given in reference 2.11.

Failure of nonstructural elements pose a threat to the occupants of the building. Falling partitions, light fixtures, shelving, and the like are very hazardous. Furthermore, debris piled in corridors and stair wells (fig. 2.26) would be a barrier to egress and a hazard in the panic conditions during evacuation of the building.

Building Damage due to Extreme Wind

It has been observed that properly designed and constructed modern buildings will stand up relatively well under extreme winds. There is no documented evidence that indicates a complete collapse of engineered multistory buildings in severe winds. To date, only three completed highrise buildings suffered severe damage to the structural frame. Two buildings in Miami, Florida were subjected to hurricane winds of 152 miles-per-hour in 1926 and were distorted severely [2.12]. The third one in Lubbock, Texas was subjected to estimated tornado winds of over 150 miles-per-hour in 1970 and suffered severe damage to the structural frame [2.13]. This building was displaced laterally to such an extent that many interior gypsum block partitions suffered extensive damage.

Structures that are highly susceptible to severe wind damage are one-or-two story industrial buildings with long-span roof, one-story pre-engineered structures and residential structures including mobile homes. Damage

to these types of structures from high winds is well documented [2.13, 2.14, and 2.15]. Extreme local wind pressures, usually negative in character, are common causes of failures of building elements. Uplifting of roofs and separation of exterior cladding from the building are the results of extreme suction forces. Several examples of such failures are shown in figures 2.27 through 2.32. Damage to windows and other exterior cladding may result from missile impact of wind-born debris, such as gravel from the roofs of adjacent buildings and other objects such as building materials stored at a nearby lumberyard. Severe damage to glazing of a high-rise building from wind-born gravel in the Lubbock tornado is shown in figure 2.33.

It has been shown that proper anchorage of roof, exterior cladding and window frames, can substantially reduce wind damage [2.16]. The anchorage factor is considered in the evaluation of damage to these items in the damage evaluation methods. In addition, inter-story drift values are used in assessing partition and glass pane damage in shear as these are related to sway motion of the building.

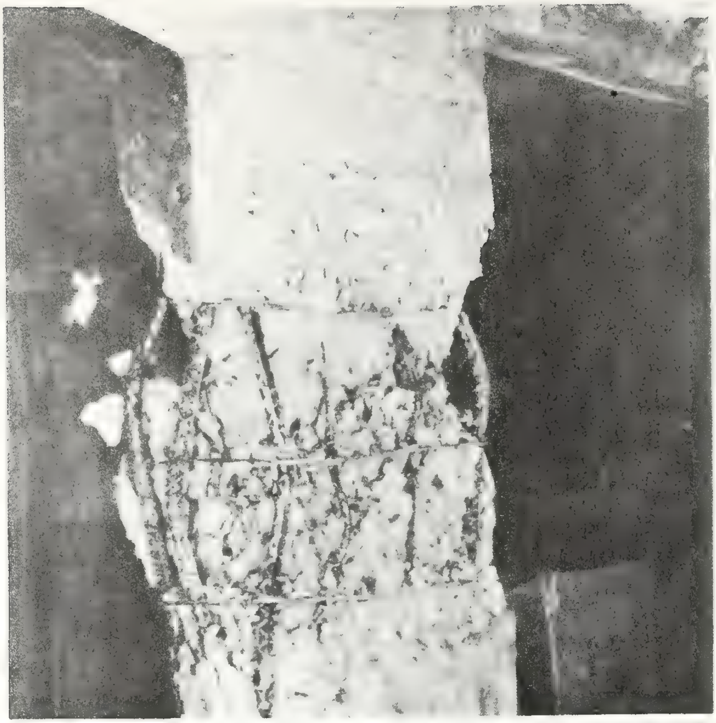


Figure 2.12 Compression Failure of Reinforced Concrete Column at Upper End.

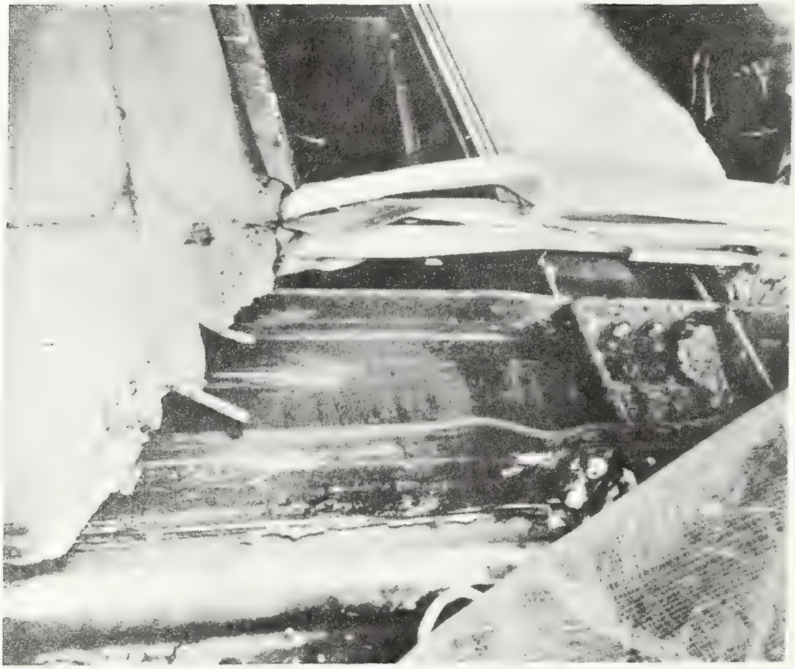


Figure 2.13 Local Flange Buckling of Steel Column at Upper End

Figure 2.14 Failure at Beam-Column Joint of Reinforced Concrete Column

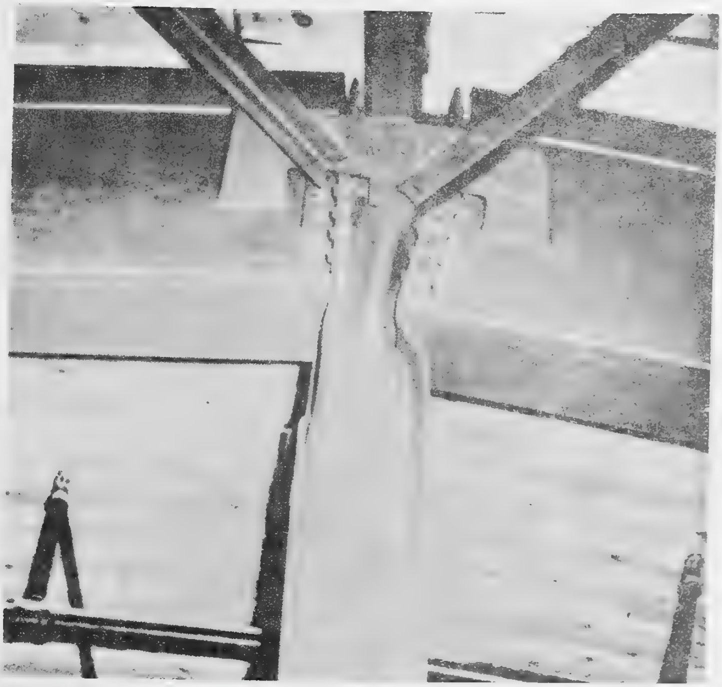


Figure 2.15 Failure of Panel Zone (Beam-Column) of Steel Frame

Figure 2.16 Diagonal Tension Cracks in Shearwall

Figure 2.17 Diagonal Tension of Reinforced Concrete Column

Figure 2.18 Diagonal Tension Cracks in Concrete Pier

Figure 2.19 Failure of Concrete Floor Diaphragm

Figure 2.20 Severely Damaged Unreinforced Masonry Infilled-Wall Frame Structure

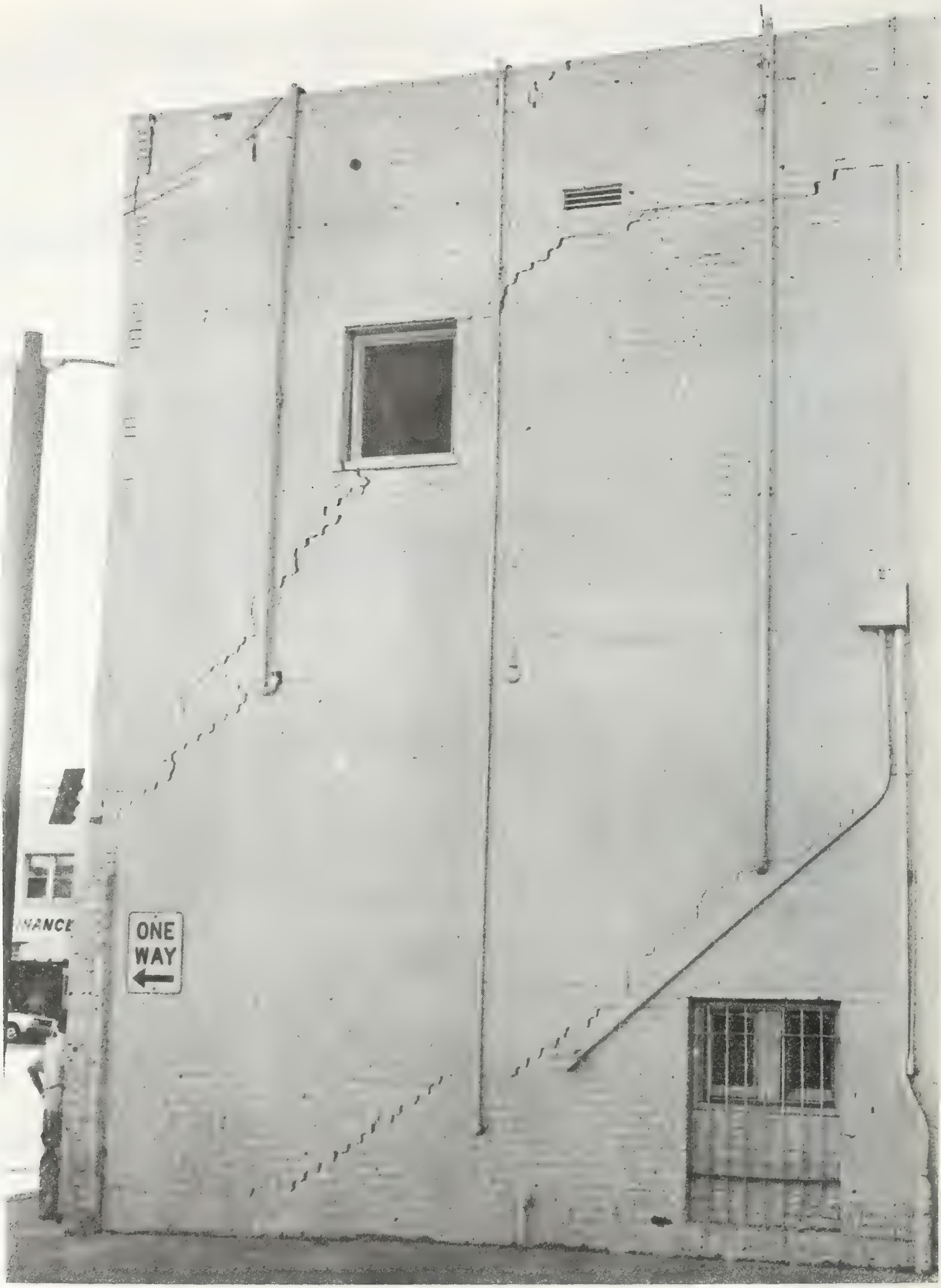


Figure 2.21 Diagonal Cracks in Unreinforced Masonry Load-Bearing Wall

Figure 2.22 Failure of Door Lintel

Figure 2.23 Damaged Reinforced Concrete Shear Wall-Frame Structure (Note Severe Lateral Displacement at the First Story Level due to elimination of Shear Wall)

Figure 2.24 Distorted Light Wood Frame Structure

Figure 2.25 Distorted Steel Frame Structure

Figure 2.26 Staircase Littered with Debris of Enclosure Partitions

Figure 2.27 Partial Loss of Roof due to a Hurricane

Figure 2.28 Total Loss of Light-Gage Steel Roof due to a Tornado

Figure 2.29 Damage to Exterior Brick Veneer due to Extreme Local Suction Pressure

Figure 2.30 Total Failure of Window Casing

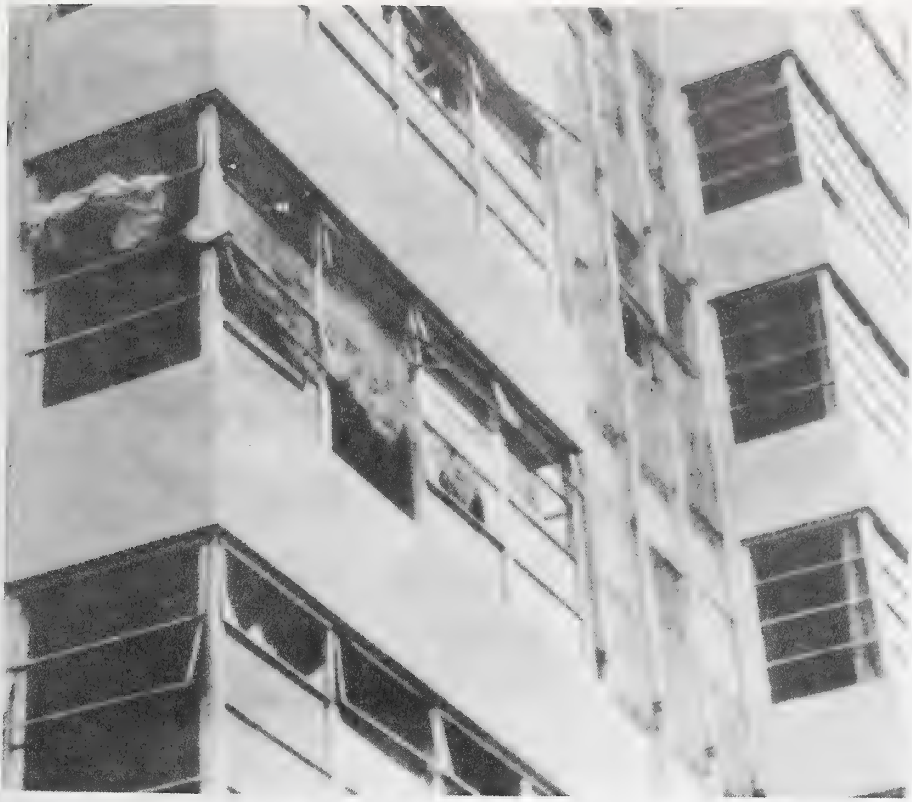


Figure 2.31 Window Damage at Corner of Building

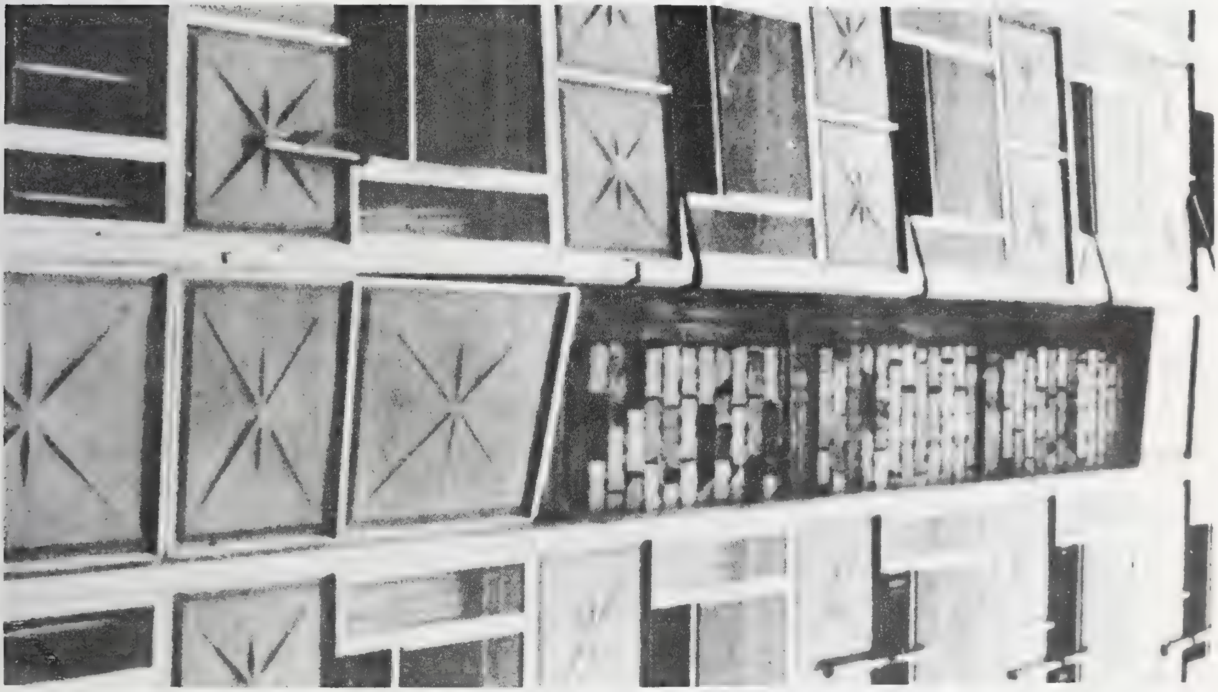


Figure 2.32 Wall Damage due to Local Wind Pressure

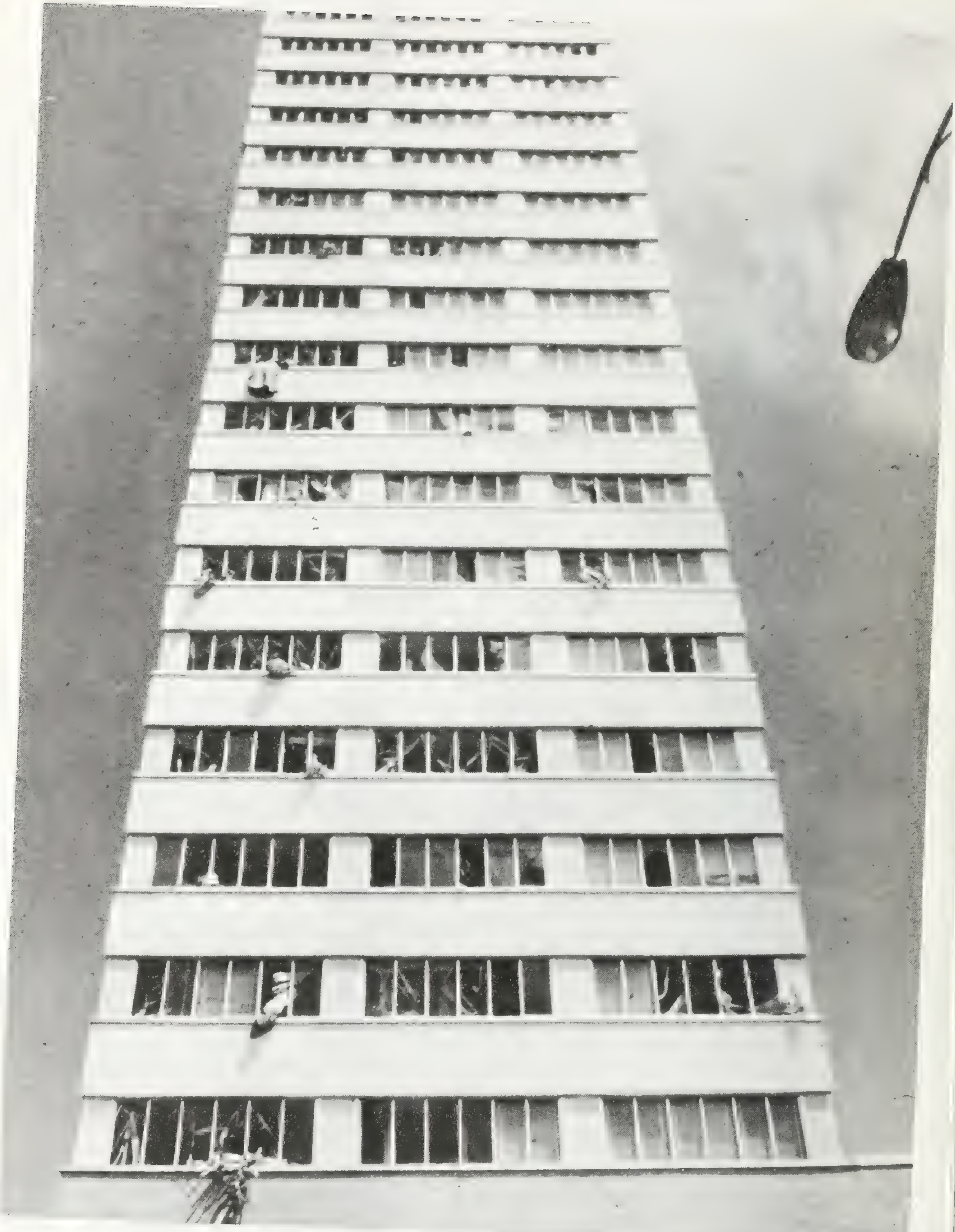


Figure 2.33 Glazing Damage due to Wind-Born Debris

3. DAMAGE EVALUATION METHODOLOGY

3.1 INTRODUCTION

This chapter presents a description of the three damage evaluation procedures included in the Damage Evaluation Methodology. Each procedure represents a different level of analytical sophistication. Each considers natural loading conditions encountered in earthquakes, winds, hurricanes and tornadoes. Existing historical seismic and meteorological data are used for determining the magnitude and recurrence interval for these hazard loadings. The types of structures considered include braced and unbraced steel frames, concrete frames, shear wall structures, combination frame and shear wall structures, bearing wall structures, and long-span roof structures.

The three damage evaluation methods are referred to as the Field Evaluation Method, the Approximate Analytical Evaluation Method and the Detailed Analytical Evaluation Method.

Section 3.2 outlines the Field Evaluation Method. In this method buildings are evaluated in terms of structural characteristics, structural configuration and the degree of deterioration of the building. A field survey of the building is used to gain information on these parameters. This method provides a rapid, inexpensive means for identifying clearly hazardous structures or potentially hazardous ones requiring a more detailed analysis to estimate damage. Chapter 4 presents an example of this method and Appendix B contains the procedures for using the method.

In the Approximate Analytical Evaluation Method, presented in section 3.3, buildings are evaluated in terms of the behavior of critical structural members. The procedure requires an analysis of the structure to identify critical members and determine the stress level induced in these members by the extreme environments. A set of building plans, specifications, and construction drawings are needed to obtain the necessary data required to perform the analysis. The method can be used to determine the damage level for buildings indentified by the Field Evaluation Method as requiring further analysis. Chapter 4 presents an example of the method and Appendix C contains the procedures for using the method.

In the Detailed Analytical Evaluation Method presented in section 3.4, the damage level is evaluated on the basis of the energy capacity of the structure. This procedure requires the use of a digital computer program for the evaluation. As in the Approximate Analytical Evaluation Method, the building data needed for input to the computer program would be obtained from a set of building plans, specifications and construction drawings. It is envisioned that this procedure would be used for more complex structures or critical facilities such as hospitals, communication centers, etc. Chapter 4 presents an example of the method. Figure 3.1 presents a schematic of the method which is used to evaluate buildings. The procedures for this method are given in Appendix E.

Prior to a detailed reading of this chapter, it is suggested that the reader examine the complete chapter to obtain an overall view of the complete methodology. Three items will be apparent from such an overall examination. First, each evaluation method can, in most cases, be conducted independently of the other two and hence is basically self-contained. Second, all three methods utilize professional engineering experience as expressed through codes. Of course, the Detailed Analytical Evaluation Method, because of its state-of-the-practice goal attempts to project beyond the present codes in many respects. Third, the amount and diversity of material for each method is considerable. The attempt was made, therefore, to present each method in such a manner that the user may read, study and master the methods one at a time. Some repetition of tables and figures was used with reader ease in mind and with the desire to reduce cross-referencing between sections.

Considering that there are three evaluation methods, a natural question to ask is, "Which method should I use for my building?" After studying the three methods it will be seen that for buildings which may be in serious danger, or for special structures of high public importance, a complete study should be performed. This involves use of all three methods. Each will provide valuable engineering insight into the potential forms and types of structural damage. While the detailed analytical evaluation method utilizes more state-of-the-art representation of loadings and matrix analytical modeling methods it is usually desirable to have this augmented by the feel for structural component performance obtained from the other methods.

The engineering time and cost is of course a function of the method selected. In general, the detailed analytical evaluation method will involve the most time and will provide the best prediction of damage. However, options exist within the computer program of the detailed analytical evaluation method which only require limited information and can be used for obtaining "ball park" estimates of damage.

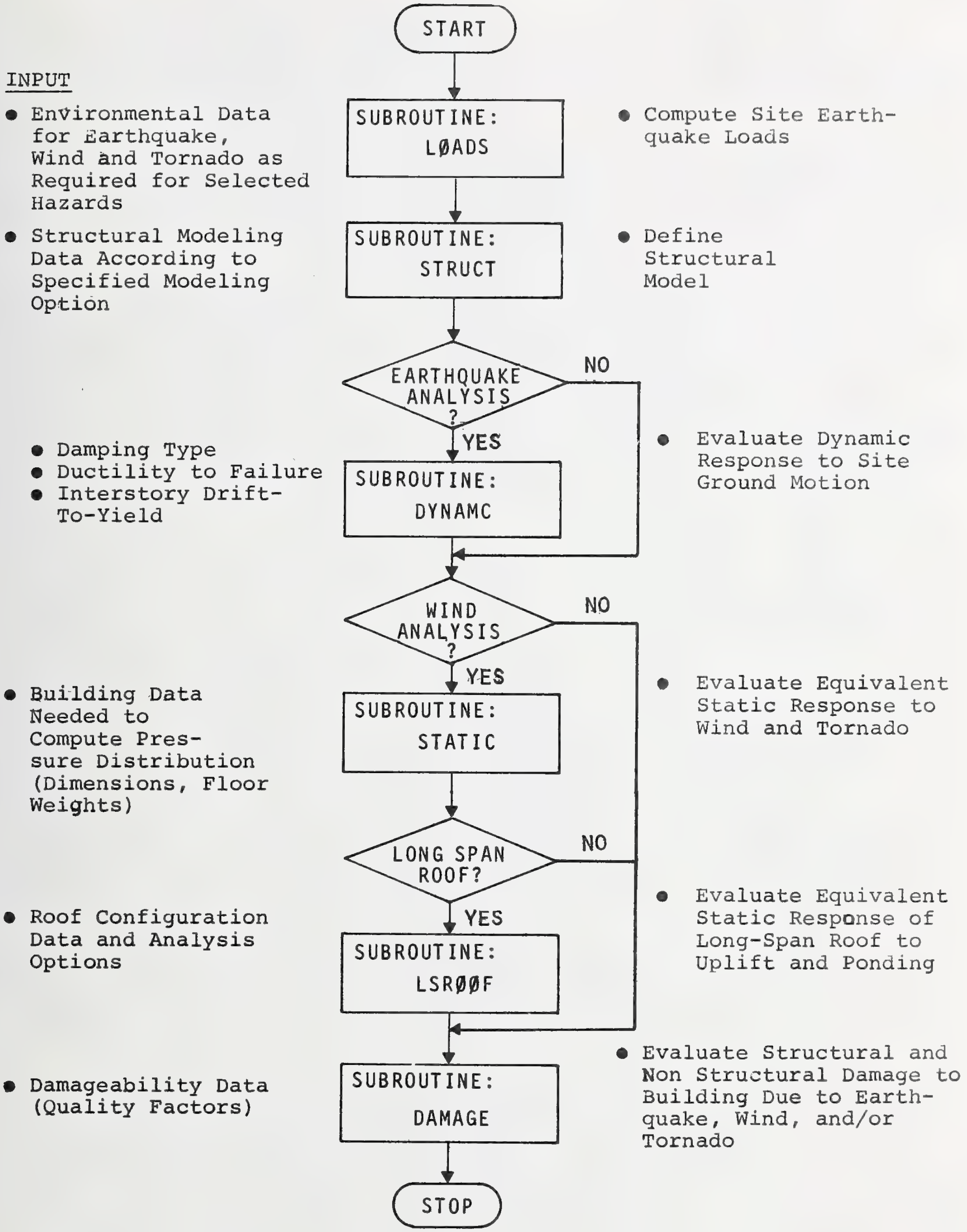


Figure 3.1 Schematic of Program

3.2 FIELD EVALUATION METHOD

A. Introduction

The Field Evaluation Method can be used where evaluation results do not need to be as refined as would be expected from the other two methods. This method is particularly applicable if building plans are not available.

The purpose of the field evaluation is to determine the adequacy of the facility in question to resist the natural hazards of earthquake, wind and tornado that the facility may be subjected to.

The site will be assigned by the user an MMI intensity for earthquakes, a probable wind intensity and exposure and the probability of tornado occurrence. It may be determined that the possibility of a particular building being subjected to one of these natural hazards is so remote that it need not be evaluated for this hazard. The rest of the information necessary for evaluation of a structure by the Field Evaluation Method must be obtained from a field inspection or from plans (if they are available) or both. If plans are available, they should be checked in the field to see that they represent the "as built" condition. Data Collection Forms have been prepared for noting most of the pertinent items that will be required to fill out the rating forms for the building evaluation. The Field Evaluation Method is accomplished by completing the evaluations required on the FM forms. For assessing the earthquake hazard, form FMA-1 on the vertical resisting structural systems, form FMA-2 on the horizontal resisting structural systems, and forms FMB-1 and FMB-2 on non-structural items are used. For assessing the wind hazard, form FMA-1 and FMA-2 are used as for earthquake, FMC-1 is also used for the structural system, and FMC-2 is used for non-structural items. For assessing tornado hazards, Form FMD is used. A resume form FME is provided to indicate the overall capability of the structural system. For rating the structural systems, a 1 to 4 numerical rating is used. For non-structural items a letter rating of A,B,C or X is used. A copy of each of the forms noted in this section are shown in Appendix B and should be referred to for the following discussion.

B. Ratings of the Structural Systems - Earthquake and Wind (FMA Forms)

FMA Forms are provided for Field Evaluation Method ratings of the structural systems. Since earthquakes do not have a prevailing direction of motion, buildings are rated for their capability to resist lateral forces in the direction of each principal axis. Therefore, a separate rating is given for longitudinal and transverse resisting elements.

If there is little difference between longitudinal and transverse resisting elements, one of the ratings may be filled out and the other noted "Similar to ______." The horizontal resisting elements (diaphragms or horizontal bracing) in most cases will have similar ratings in both directions except where the diaphragms or bracing may not be complete between vertical resisting elements in each direction.

On Form FMA-1, "General Ratings (GR)" are assigned to the various types of framing in order to account for past performance and the degree of uncertainty that the building would perform in a manner anticipated for the type. These ratings are based on damage experience and judgment. For instance, it may be known that a building is a steel frame structure, but unless plans are available, it may not be possible to determine whether the beam-column connections are moment-resisting, or to what degree they are moment-resisting. In such cases it is suggested that the Type B rating be used. Similarly, in concrete where a visual inspection cannot determine the extent of reinforcement, it will not be known whether the frames are designed to resist moments and forces from horizontal motions. Type D is suggested for this case.

Wood stud walls may have various types of sheathing or combination of sheathing and plaster. For wood frame buildings of Type K, where plywood sheathing is used and is well nailed and blocked, a rating of 1 is suggested; otherwise, use the 2 rating.

The General Ratings for wind vary in some cases from those for earthquakes. Unless a building is very long and narrow, the total wind force acting on the building as a whole (except for tornadoes) is usually less than the earthquake force. In general, buildings of heavy construction in any area are less susceptible to wind than to earthquake damage when compared to buildings using light construction.

For masonry buildings of Type E, wind ratings of 2 or 3 are listed. As examples, if the masonry shear walls divide a building into nearly square areas, use the 2 rating. If a building is long and narrow, say 150 ft x 50 ft, with no interior walls that will act as shear walls, use the 3 rating.

For wood frame buildings of Type K, where it can be confirmed that there is well nailed and blocked plywood sheathing, use a wind rating of 2. Otherwise, use the rating of 3.

The column headed "Symmetry of Resisting Elements" describes the eccentricity between the center of mass of the structure and the center of stiffnes of the vertical resisting elements. Thus, in a building where the only shear walls are the exterior walls with only one opening in the center of the opposite walls, and the building plan is rectangular, the building would be classified as Symmetrical. On the other hand, a two-story rectangular structure with nearly solid side and rear walls, but with a front wall almost entirely glazed with perhaps only four small piers or columns, would be classified as Very Unsymmetrical.

In the case of a multi-story building with a complete vertical load-carrying frame (i.e., without bearing walls), with columns uniformly spaced and reasonably uniform in size, a Symmetrical or Fairly Symmetrical classification would be given. Whether or not beams or girders frame into the columns with connections capable of taking significant bending moments may affect the symmetry. Portions of the building may have girders framing into columns in one direction with light beams or slabs framing to columns in the other direction. In such cases, the stiffness or rigidity of such bents would be greatly different and thus affect the symmetry. If plans are available, the symmetry can readily be determined; if not, best judgment should be exercised.

Symmetry can be greatly affected by location of mass. For instance, there may be only a partial third story over two full stories. This could produce dissymmetry unless the vertical resisting elements are correspondingly increased under this third story area.

Where rigid concrete floor, or roof diaphragms are involved, the effect of unsymmetrical vertical resisting elements is reduced, since such diaphragms can develop considerable torsion. For this reason, two rating numbers are provided for unsymmetrical systems - with the lowest number to be used where concrete diaphragms are present.

Some buildings have very rigid vertical resisting elements (such as shear walls) in the upper stories, but these are omitted in the lower story. This leaves only the columns and girders acting as a moment resistant frame for the horizontal resistance. A flexible first story such as this can create a dynamic response which could be very adverse and in a severe earthquake, could cause severe damage unless the design is based on an analysis considering dynamic response. Unless computations are available which show that this has been done, the Symmetry rating should be given a one point increase, but need not exceed 4.

The column headed "Quantity (Q)" refers to the number of vertical resisting elements. If there are many long shear walls this rating is 1. If there are so few shear walls that each is vital to resist lateral motions, the rating could be as much as 4. Intermediate conditions would have ratings between these extremes. One exception would be when shear walls occupy at least 75% of the exterior wall length, in which case the quantity rating would be 1 even though no interior walls are present.

In the case of moment-resisting frame structures of steel or concrete, both the strength and number of columns is important. For the usual case of multiple 20 ft to 35 ft bays, the Quantity rating would be 1. There are cases, however, where an entire building may be supported by only 4 large columns. In such cases the failure of one support would cause collapse. A Quantity rating of 4 would be appropriate. Similar reasoning would provide each building with its individual Quantity rating. In multi-story structures, the Quantity rating should be made for the worst condition in any story level.

Since Symmetry and Quantity values are interrelated and dependent on each other, a combined factor (SQR) will be used as a Sub-Rating. The SQR rating is the average of the Quantity rating and the Symmetry rating.

The columns headed by "Present Condition (PC)" is where wall cracks and other damage as described on the DC Form, see Appendix A, is evaluated. "Other Damage" may be damage caused by deterioration from lactic or tannic acid (frequently found in dairy or slaughterhouse facilities) or from severe popping of concrete caused by the use of reactive aggregates. The degree of damage in such cases can only be estimated by visual observation for the Field Evaluation Method ratings.

For vertical resisting elements consider "Quantity" and "Symmetry" combined as one factor and "Present Condition" as another factor with which a weighted average is found to produce "Sub-Rating (SR1)." This formula is based on experience. The procedure for finding the "Sub-Rating" is shown on Form FMA-1.

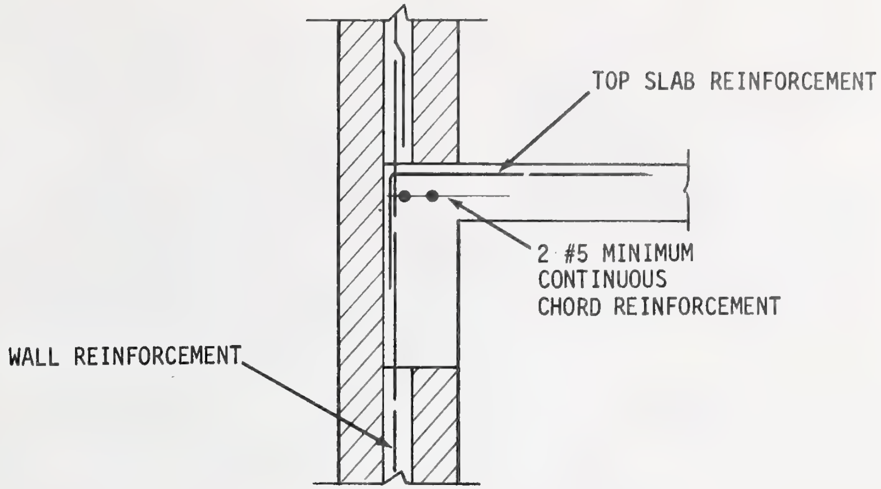
On Form FMA-2, horizontal resisting elements (floors or roofs) are evaluated. These are important elements in the capability of a building to withstand lateral forces. In earthquakes, the lateral forces originate at the centers of mass or weight. In the case of wind, the forces are usually applied laterally at the exterior walls and also with positive or negative pressures on the roof.

The floor or roof systems act as horizontal diaphragms to distribute horizontal forces to the vertical resisting elements, such as shear walls, moment-resisting frames, or braced frames. This diaphragm action is similar to that of a horizontal plate girder spaning between the vertical resisting elements and may be continuous over several supports. In this analogy the floor itself may be compared to the plate girder web, and the marginal beams or walls (chords) compared to plate girder flanges. The floor or roof system, acting as a girder web, is primarily a shear resisting element. The marginal beams or girder flanges (chords) in diaphragm action are primarily subjected to axial loads of tension or compression. Figure 3.2 shows examples of marginal concrete beams acting as chords. Wood, steel, or reinforced masonry beams also used where applicable.

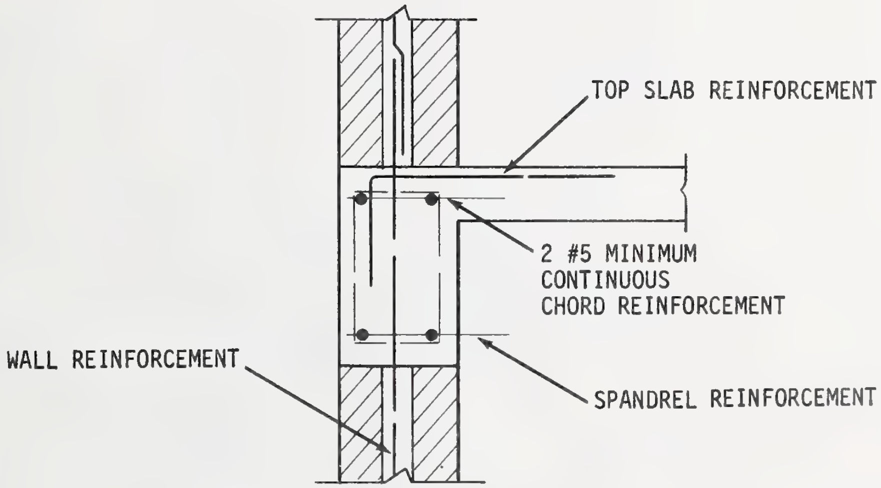
Shears are transferred by the anchorage between floor or roof and the shear walls or frame members. The DC form has spaces for describing these anchorage connections. The determination of the adequacy of anchorage or connections involves considerable judgment unless computations are made. The provisions of the local building codes may assist in this. If the date of construction of a building is known the applicable building code requirements of that data may be determined. If the governmental agency granting a permit had a good enforcement record at the time, it is probable that the anchorage details conform to the code requirements then in effect. There are areas, however, where there is or has been very little building code enforcement in the past. In such cases, conformance with code requirements applicable at the time of construction may be very questionable and greater dependence on visual inspection is necessary.

Where the floor or roof systems are of cast-in-place concrete and are placed integrally with portions of the shear walls or frames, generally a good anchorage with shear transfer capacities can be assumed dependent on the concrete strength, concrete slab thickness and amount and anchorage or reinforcing steel. The rating given would be 1 or 2.

With metal deck systems, the diaphragm values are dependent on the deck configuration, attachment between units, gage and attachments to supports. Where a structural concrete topping slab is used, dowels or other connections to supporting and marginal members may be used. The welding pattern of deck to steel supporting members has a large influence on the shear capability of this type of deck, as well as the ability of the deck to transfer horizontal loads to vertical resisting elements or chord members. Screw-type connection of metal decks to steel supporting members are sometimes used in lieu of welds. Figure 3.3 illustrates some typical metal deck connections.

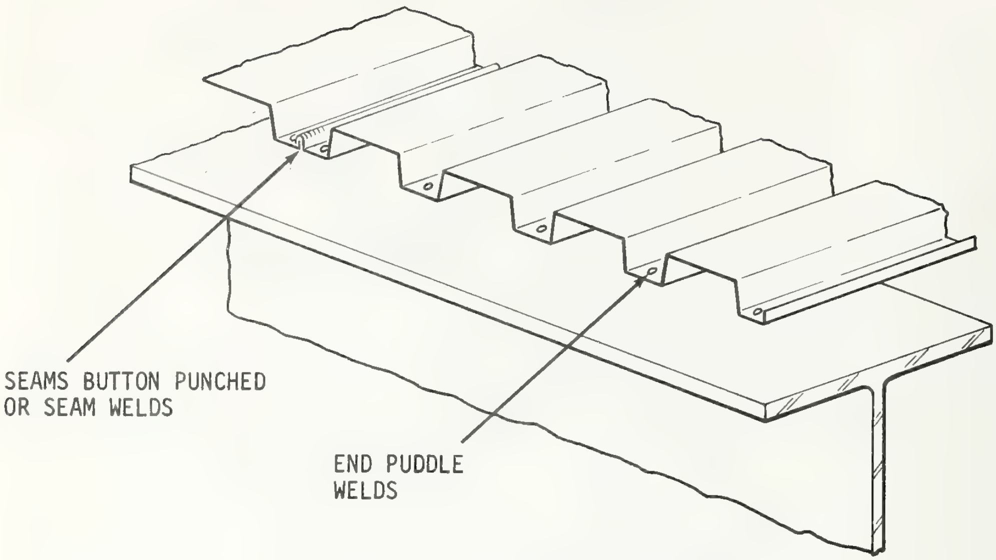


DETAIL A

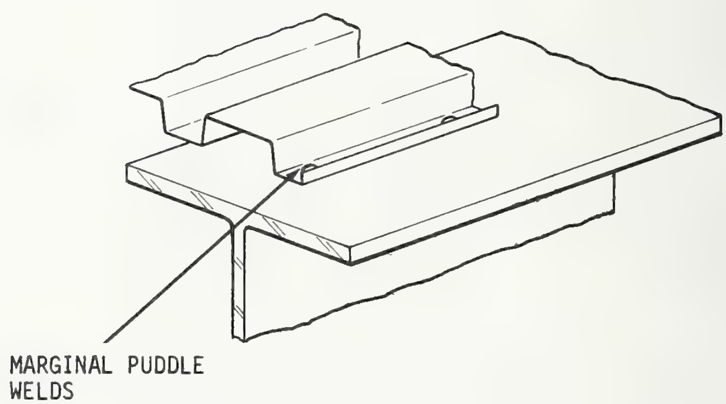


DETAIL B

Figure 3.2 Typical Concrete Diaphragm Chord Details



CONNECTION TO MARGINAL BEAMS



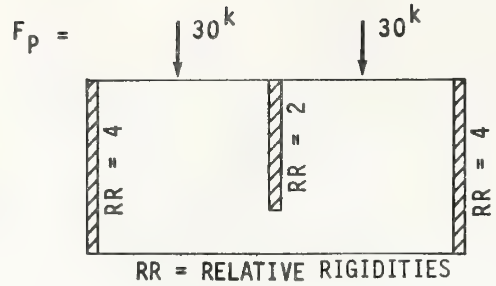
END CONNECTION TO SUPPORTING BEAMS

Figure 3.3 Typical Deck Connection Details

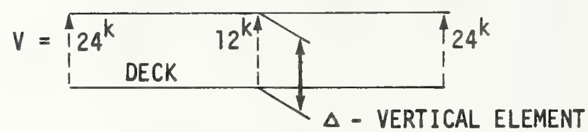
Where wood floor or roof systems are used as horizontal diaphragms, the connections to shear walls and frame elements is also very important. In areas where lateral force resistance is not required by code, there is a commonly used detail where floor joists or roof rafters are "fire-cut" into a masonry wall and anchored to the wall with a tee head self-releasing steel anchor, usually 5/8 in or 3/4 in diameter. This anchor has a 90° bend which is inserted into the side of the wood member. This is a good detail for fire hazard since it allows a burned joist to fall and pivot without pulling in the wall. However, this type of anchorage has very little value in transferring horizontal shear from floor to wall and is generally not accepted as a satisfactory earthquake resistant anchorage detail unless supplemented by other anchorage and shear transfer methods.

In many cases, it will not be possible to visually examine some of these connections and anchorage details. The plans, if available, may show these connection details. However, some clues may be available. For instance, the attic space may be accessible. If so, the connections of the roof to the walls may be seen with a flashlight. If the roof rafters are "fire-cut" into the bearing masonry walls and anchored with the T head anchors previously described, it is reasonable to assume that such walls are not reinforced unless there is real evidence to the contrary. Any information that can be obtained about the fastening of elements in the roof and floor system should be noted on the forms. The ratings on Form FMA-2 for "Anchorage and Connections (A)" are approximate, recognizing the difficulty in a thorough evaluation without calculations.

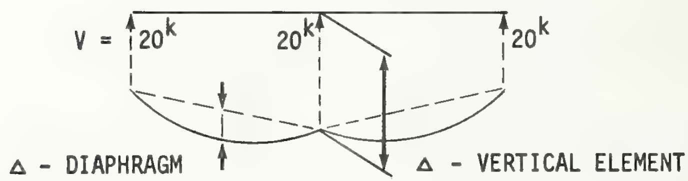
The flexibility of diaphragms is quite important. A rigid diaphragm will distribute horizontal forces to vertical resisting elements in proportion to the relative rigidities of those elements. A flexible diaphragm cannot do this and the distribution of lateral forces is therefore dependent on the masses tributary to the vertical resisting elements. The diaphragms, if very flexible, could be insufficient support for the wall elements, permitting the walls to fail as cantilevers. However, actual damage from lateral forces caused by flexible diaphragms has generally not been severe. For this reason the lower limit of 2.5 on the Rigidity Rating (R) has been used so as to reduce the importance of this factor in comparison with other factors in the overall rating. Figure 3.4 illustrates the relative effects of diaphragm stiffness on the distribution of lateral force to the vertical elements, e.g. columns and shear walls.



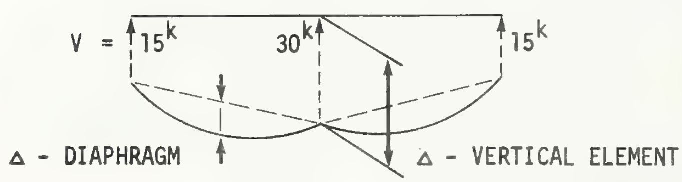
SCHEMATIC PLAN



RIGID DIAPHRAGM



SEMI-RIGID DIAPHRAGM



FLEXIBLE DIAPHRAGM

Figure 3.4 Relative Effects of Diaphragm Stiffness on Distribution of Lateral Forces to Vertical Resisting Members

For the Field Evaluation Method, where there will be no analytical evaluation, reasonable approximations must be made as to rigidity. The suggested classes of rigidity are as follows:

Rigid	- Diaphragm of cast-in-place concrete.
Semi-Rigid	- Metal deck diaphragms with structural concrete topping.
	Metal deck systems made up of one fluted element and one flat element.
	Pre-cast concrete elements with structural concrete topping.
	Horizontal steel bracing.
	Steel deck systems with insulating concrete fill.
Semi-Flexible	- Well blocked and nailed plywood.
	Double diagonal sheathing or straight sheathing plus diagonal sheathing.
	Metal decks with fluted elements only.
Flexible	- Unblocked plywood.
	Diagonal wood sheathed floors or roofs.
	Straight wood sheathed floors or roofs.
	Corrugated iron roofing (screw fastened).

The existence of tension and compression chords for the diaphragm or horizontal bracing may or may not be easily determined by visual inspection. In the case of a steel frame industrial type structure with exposed roof, the steel members may be visible. In reinforced concrete buildings, a portion of the exterior concrete wall near the floor line can act as a chord if reinforced. There will probably be some horizontal reinforcing steel, but without plans the capacity of the chord is unknown. In such a case use a Chord Rating (C) of 2. In masonry walls known to be unreinforced, it is probable that no chord steel has been provided; in such a case use a Chord Rating of 3. In wood frame walls, where rafters or floor joists bear on a double plate, a chord can be formed by this double plate.

The Sub Rating (SR2) is assigned the highest individual rating as the individual ratings of horizontal resisting elements are independent of one another.

C. Rating of Other Life Hazards - Earthquake (FMB Forms)

Forms FMB are provided for the evaluation of life hazards originating from sources other than the basic structural systems. These ratings assess the individual element hazard only. For the purpose of this method, the following additional life hazards are considered:

Collapse of Exit Corridor or Stair Enclosure Walls.
Collapse of Other Partitions.
Glass Breakage.
Falling Exterior Appendages or Units of Wall Cladding.
Excessive Gas Leakage.
Falling Ceilings.
Falling Light Fixtures.

Collapse of Exit Corridor or Stair Enclosure Walls (FMB-1)

If exit corridors or stairs are enclosed by brittle, unreinforced masonry wall elements, the wall elements may become badly cracked in a severe earthquake, particularly those which are tightly enclosed by the structural frame. Sometimes they even appear to explode. This is the type of failure that can occur where earthquake motions are parallel to the walls. Where the earthquake forces are normal to the plane of the wall, the walls will tend to bend as a slab. If they are incapable of taking tension, they could fail in flexure. When walls are only of moderate height, the anchorage of walls to frame elements could be critical. Failure of the anchorage could allow a wall to topple over.

Where the exit enclosure walls are well reinforced, they may crack when subjected to severe earthquake motions. Because of the basketing effect of the reinforcing steel, collapse is much less probable. The risk of having a wall falling out to injure people or having debris clutter up the exit way is reduced. The same comments apply to unreinforced and reinforced concrete walls.

Exit way enclosure walls using metal studs and plaster may have some cracks, but there is a considerable basketing effect so that only small portions would tend to fall. Thus the life hazard risk is considerably less. The use of dry wall over metal studs forms a wall that can take some distortion. Some cracks may occur, usually at the dry wall joints and some fastenings may come loose. However, the life risk here is also comparatively low. The fastening and support of the top and bottom tracks is important so that the entire wall will not topple. Wood studs and plaster can take considerable distortion also and are considered in the low risk category as far as a hazard to occupants is concerned.

Collapse of Other Partitions (FMB-2)

The same comments apply here as to exit corridor or stair enclosure walls as to the causes of damage and type of damage expected. In buildings where the vertical loads are supported by a standard frame system, however, these "other partitions" are more likely to be non-bearing and removable. In many cases they will be supported by the floor below and attached to the ceiling but not to the structural floor above. The anchorages in both cases are important to the stability of the partitions during an earthquake. This is discussed under the "Falling Ceilings" hazard.

Glass Breakage (FMB-2)

Glass breakage can occur when the glazing and setting of the glass does not permit sufficient movement of the enclosing structural frame relative to the glass pane. For instance, if the story-to-story drift of a building were 1/2 inch and the glass pane were of a height equal to half the story height, a quarter inch of play in the glazing setting would be required. Otherwise the glass will crack. Most of the glass breakage during earthquakes is caused by forces parallel to the plane of the glass. This is in contrast to wind, where risk of breakage is a result of relatively higher normal pressure and glass may break in flexure.

The Uniform Building Code (1973 edition) as published by International Conference of Building Officials contains minimum glazing requirements, shown here in table 3.1 [2.5]. These requirements are reproduced as a guide to recommended hazard reduction requirements in areas where earthquakes are anticipated. If possible, the conformance to these provisions should be determined where glass windows and doors are so located that breakage could endanger life in public ways, exit corridors or stairs. Some typical details providing for drift are shown on figure 3.5.

Falling Exterior Appendages or Units of Wall Cladding (FMB-2)

Exterior appendages or wall cladding elements, unless properly anchored to the basic structure, pose a high hazard to life if located above a public way or other locations where people will normally congregate or pass. Exterior appendages may be architectural ornamentation of cast stone, precast concrete, or terra cotta. These are relatively heavy. On the other hand, some may be made of sheet metal and be comparatively light. Wall cladding may be heavy or light and composed of thin veneer or stone, clay products, or metal. The degree of hazard depends primarily on the anchorage which should be able to resist lateral forces or motions which are a function of the weight of the element, the flexibility of the frame, and the seismicity of the area involved. Both spacing and strength of anchors should be determined. See table 3.2 for a listing of the probable type of anchorages to be found for different wall cladding materials.

Table 3.1 MINIMUM GLAZING REQUIREMENTS

FIXED WINDOWS AND OPENABLE WINDOWS OTHER THAN HORIZONTAL SLIDING					
GLASS AREA	Up to 6 Sq.Ft.	6 to 14 Sq.Ft.	14 to 32 Sq.Ft.	32 to 50 Sq.Ft.	Over 50 SqFt
Minimum Frame Lap	1/4"	1/4"	5/16"	3/8"	1/2"
Minimum Glass Edge Clearance	1/8" [1,2]	1/8" [1,2]	3/16" [1]	1/4" [1]	1/4" [1]
Continuous Glazing Rabbet & Glass Ret.[3]	REQUIRED	REQUIRED	REQUIRED	REQUIRED	REQUIRED
Resilient Setting Material[4]	Not req'd.	REQUIRED	REQUIRED	REQUIRED	REQUIRED

SLIDING DOORS AND HORIZONTAL SLIDING WINDOWS				
GLASS AREA	Up to 14 Sq.Ft.	14 to 32 Sq.Ft.	32 to 50 Sq.Ft.	Over 50 Sq.Ft
Minimum Glass Frame Lap	1/4"	5/16"	3/8"	1/2"
Minimum Glass Edge Clearance	1/8" [2]	3/16"	1/4"	1/4"
Continuous Glazing Rabbet and Glass Retainer[3]	REQUIRED ABOVE THIRD STORY	REQUIRED	REQUIRED	REQUIRED
Resilient Setting Material[4]	NOT REQUIRED	REQUIRED	REQUIRED	REQUIRED

1. Glass edge clearance in fixed openings shall not be less than required to provide for wind and earthquake drift.

2. Glass edge clearance at all sides of pane shall be a minimum of three-sixteenths inch where height of glass exceeds three feet.

3. Glass retainers such as metal, wood or vinyl face stops, glazing beads, gaskets, glazing clips, and glazing channels shall be of sufficient strength and fixation to serve this purpose.

4. Resilient setting material shall incluce pre-formed rubber or vinyl plastic gaskets or other materials which are proved to the satisfaction of the Building Official to remain resilient.

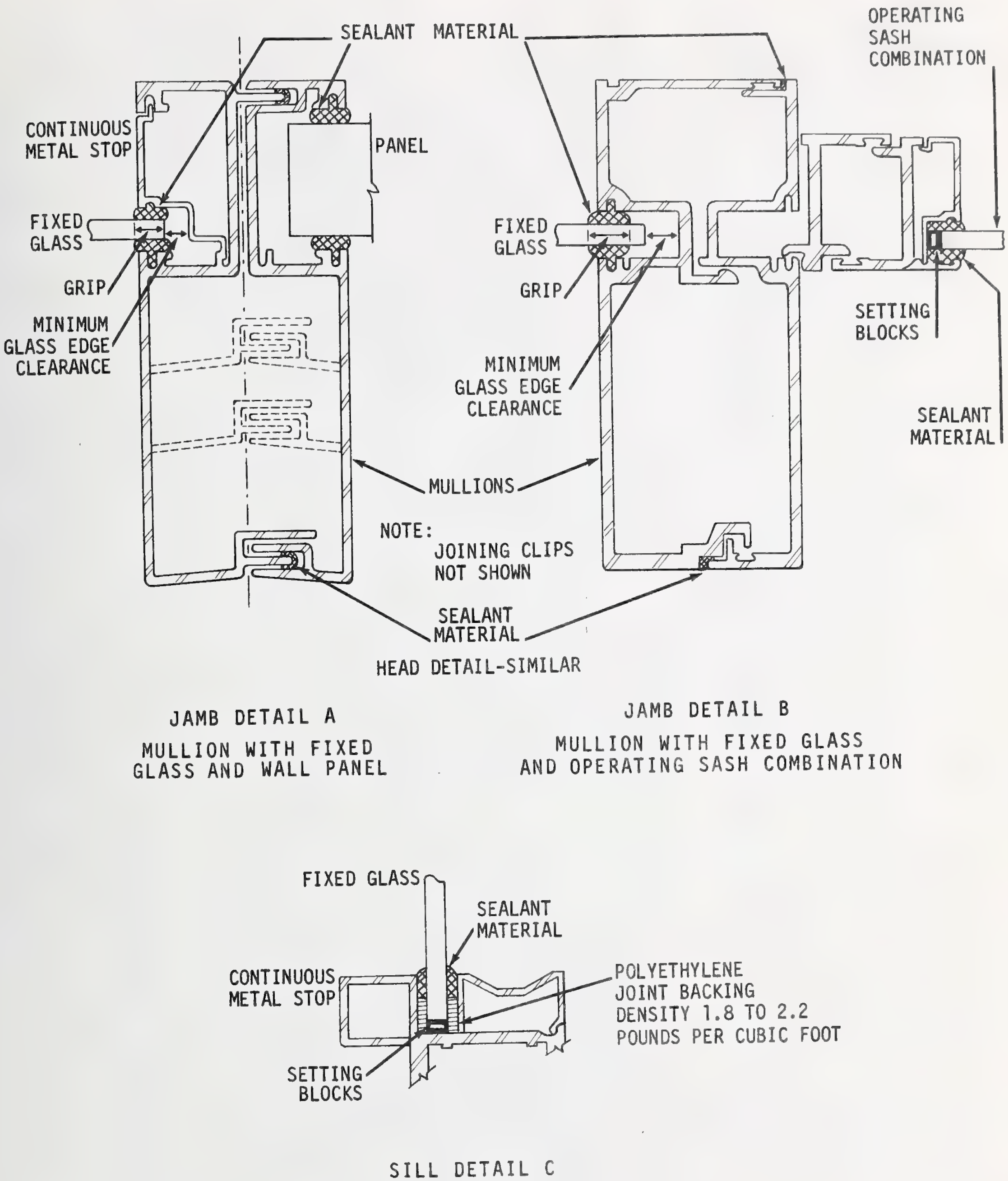


Figure 3.5 Typical Window Details

Table 3.2 PROBABLE TYPES OF ANCHORAGE FOR EXTERIOR APPENDAGES AND WALL CLADDING

TYPE	WEIGHT CATEGORY	TYPE OF ANCHORAGE					
		Steel Rods	Dovetail Slots	Weldments	Adhesive	Bolts or Screws	Mortar only
Cast Stone or Stone	Heavy	X	X				X
Terra Cotta Thick	Heavy	X					
Terra Cotta Thin	Light	X			X		
Precast Cement	Heavy	X		X			
Marble Thin	Light				X		
Sheet Metal	Very Light					X	
Masonry Veneer	Heavy		X				

All of the above types of anchorage can be considered good if present and at close enough spacing and have adequate strength, except for the "Mortar Only" type.

Excessive Gas Leakage (FMB-2)

The breaking of gas lines during an earthquake can result in excessive leaks which would lead to serious fires or explosions. Special automatic gas shut-off valves have been developed for areas of high seismicity which, if used, would mitigate this hazard. Flexible type connections just outside a building are sometimes provided to minimize the risk of a rupture at that point. A typical specification for earthquake valves reads as follows:

> "Earthquake valves shall be furnished complete with remote manual control. This control shall be mounted in an acceptable location on the exterior of a building or meter enclosure 6 ft 0 in above grade and shall consist of continuous unspliced phosphor cable in galvanized steel screw pipe with brass roller elbows at each change of direction in the line."

The presence or absence of such connections should be noted.

Falling Ceiling (FMB-2)

Falling ceilings frequently have been a high hazard to life. As a building sways during an earthquake shock, a suspended ceiling may sway with its own natural period of vibration unless braced to walls or braced to structural floors with diagonal braces (usually wires). Where tee-bar system members or rolled channels terminate at a wall or other structural member, the attachment is frequently very loose and may easily slip off its support, causing the adjacent ceiling area to drop. After observing damage to suspended ceilings in recent earthquakes, earthquake resistant recommendations have been and are still being formulated to control this damage. Few existing structures are provided with ceilings designed to meet these requirements.

As a rule of thumb, the present state-of-the-art requires that suspended ceiling systems be provided with X-brace wire diagonals in addition to the usual vertical wire hangers with the spacing of these wire hangers limited to the X-bracing's ability to carry laterally 20% of the ceiling weight. The ceiling weight should include the weight of light fixtures supported laterally by the ceiling system. Where removable or demountable partitions terminate at the ceiling they must also be stayed laterally by the ceiling system and the lateral force should be added in when the adequacy of the bracing system is analyzed. Where bracing is not used and the ceiling system members are tied firmly to exterior walls or structural elements, the continuity of ceiling framing members should be investigated as well as the end connections to the walls.

Falling Light Fixtures (FMB-2)

Heavy light fixtures should generally be independently supported from the floor or roof above. Such fixtures will tend to sway and are actually pendulums. Anchorage of lighting fixtures is described in chapter 13, page 8-11, of the Tri-Service Manual [3.1]. This is reproduced here.

> Lighting Fixtures in Buildings: In addition to the requirements of the preceding paragraphs, lighting fixtures and supports will conform to the Standards for Safety UL-57 and requirements given hereinafter.
>
> a. Materials and Construction
>
> (1) Fixture supports will employ materials which are suitable for the purpose. Cast metal parts, other than those of malleable iron, and cast or rolled threads will be subject to special investigation to assure structural adequacy.
>
> (2) Loop and hook or swivel hanger assemblies for pendent fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendent supported fluorescent fixtures shall be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
>
> (3) Each recessed fluorescent individual or continuous row of fixtures shall be supported by a seismic resistant suspended ceiling support system and shall be bolted thereto at each corner of the fixture; or shall be provided with fixture support wires for individual fixtures and one wire per unit of continuous row of fixtures.
>
> (4) A supporting assembly which is intended to be mounted on an outlet box will be designed to accommodate mounting features on four-inch boxes, three-inch plaster rings, and fixed studs.
>
> (5) Each surface mounted fluorescent individual or continuous row of fixtures shall be attached to a seismic resistant ceiling support system. Fixture support devices for attaching to suspended ceilings shall be a locking type scissor clamp or a full loop band which will securely attach to the ceiling support. Fixtures attached to underside of a structural slab shall be properly anchored to the slab at each corner of the fixture.
>
> (6) Each wall mounted emergency light unit shall be secured in a manner to hold the unit in place during a seismic disturbance.

D. Rating of Building Resistance to Wind Hazards (FMC Forms)

The purpose of FMC Forms is to determine the capability of buildings to withstand wind forces that can reasonably be expected to occur in the particular area involved. A probable wind velocity will be assigned to individual areas by the user. This usually will be given in terms of anticipated wind velocities at a height of 30 ft above ground level at a mean recurrence interval. Wind velocities can be varied by such factors as height above ground and the exposure which considers the character of the environment. Research on these items has given a basis for developing criteria for effective velocity pressures based on these factors. ANSI-A58.1-1972 [3.2] (Articles 6.3.3, 6.3.4, 5.3.4.1, and 6.3.4.2) describes "Effective Velocity Pressure" and how this pressure is varied by various factors. The exposure factor of course has to be generalized. The height factor can perhaps be easily determined. Section 3.4 of this chapter discusses in detail the factors affecting and the methods of obtaining wind pressures. The reader is referred to that section in addition to ANSI-A58.1 to supplement the comments made in this section.

Damage to a building is dependent on two basic considerations. One side of the equation is the effective wind force, usually in terms of pressure, positive or negative given in pounds per square foot of surface. On the other side of the equation is the resistive capacity of the structure to lateral forces and also to uplift forces on the roof created by the structure's shape.

ANSI-A58.1-1972 is currently the most accepted source of design criteria for winds other than tornadoes. For the purpose of this report, this publication will be referred to for use in the evaluation of buildings subjected to wind hazards. Subsequent editions of ANSI-A58.1 would supersede these criteria if and when adopted. The publication gives criteria, curves, charts, and formulas for the design of structures subjected to severe winds. These criteria will be used in the evaluation of possible damage to structures by the Approximate and Detailed Analytical Methods. Criteria other than 1972 ANSI may be used but should be clearly noted on the forms.

For structures to be evaluated by the Field Evaluation Method, certain simplification must be made. The basic factors which can vary the effect of wind forces on structures are:

- Exposure
- Height
- Degree of Enclosure
- Weight and Foundation Anchorage
- Shape Factor

For simplicity all but shape factors should be considered in the formulation of a Field Evaluation Method rating.

Rating of Structural Systems - Wind (FMC-1)

This type of evaluation is limited by the information that can be collected by a field team without major calculations. The necessary information on structures for the Field Evaluation Method for both wind and earthquake is to be obtained from the DC Form. The evaluation is done on Form FMC-1.

The rating system used for structural systems in resisting earthquakes can be used also for wind because the rating is a measure of a building's ability to resist lateral forces. In the case of wind, in addition to lateral pressures, there are factors which involve high suction or uplift forces on the roofs of light buildings, overhanging roofs, roof anchorage, and anchorage to foundation and internal pressure. Internal pressures are greatly affected by the degree of building enclosure. The distribution of openings in the walls and the location of openings on windward, leeward, or side walls will also be important factors in determining actual internal pressures.

The rating of the structural system is given in the form of a ratio of the design unit wind pressure to an effective capacity unit pressure.

The "Effective Unit Velocity Pressure (P_c)" is given in pounds per square foot for each of the "Corrected Structural Ratings." Obviously, without calculation, these capacity ratings will be very approximate. They are based on experience, judgment and previous calculations made on various types of buildings.

A "Corrected Structural Rating" is determined by taking the highest numerical rating of the "Foundation Anchorage" factor, "Roof Anchorage" factor, or the "Basic Structural Rating" since these factors affect the building's capacity to resist wind independently.

In buildings subjected to high velocity winds, the entire building may have net uplift forces on the connections to the foundations. This may be quite critical in buildings with little weight to resist the uplift. An approximate estimate of the building weight will be needed to determine this factor. The roof must be adequately anchored to resist uplift forces which may exceed the weight of the roof.

Calculations for enclosure factors are beyond the scope of the Field Evaluation Method. An approximation of the degree of enclosure should be obtained from the DC Form. In unenclosed buildings or partially enclosed buildings, the uplift factor on the roof may be very severe and the "Foundation" and "Roof Anchorage" factors noted on FMC-1 should be increased numerically by half a point. The major problem involved with unenclosed or partially enclosed buildings is the anchorage of roof to vertical supports and the anchorage of wall elements. Where this anchorage is questionable or cannot be confirmed by original design computations, a review by the Approximate Analytical Method should be made.

Rating of Other Life Hazards - Wind (FMC-2)

During extremely high winds, special hazards to life may be caused by such phenomena as breaking glass, wind borne objects which in effect become missiles, and/or the tearing loose of roof panels, exterior wall panels, wall cladding or ornamental exterior appendages.

Glass in exterior walls or skylights is subjected to direct wind pressure. In a direction normal to the surface this can be much greater than earthquake forces which are a function of the weight of the glass itself. Therefore, the strength of the glass, as well as its anchorage is of utmost importance in evaluating the wind hazard. In the direction parallel to the plane of the glass, the critical item is the distortion of the enclosing frame. In a flexible structure, the glass may crack up unless the attachment to the frame allows for such distortion through the use of resilient materials or a space allowance. The size of pane should be checked with respect to these provisions.

Missile damage has been recorded in many high wind occurrences. Wind has been known to pick up gravel from roofs and even relatively heavy objects. The effects of such flying objects can be severe, such as when the point of impact is a glass panel on the exterior of a building.

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- Exposure
- Height
- Degree of Enclosure
- Weight and Foundation Anchorage
- Shape Factor

For simplicity all but shape factors should be considered in the formulation of a Field Evaluation Method rating.

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During extremely high winds, special hazards to life may be caused by such phenomena as breaking glass, wind borne objects which in effect become missiles, and/or the tearing loose of roof panels, exterior wall panels, wall cladding or ornamental exterior appendages.

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Missile damage has been recorded in many high wind occurrences. Wind has been known to pick up gravel from roofs and even relatively heavy objects. The effects of such flying objects can be severe, such as when the point of impact is a glass panel on the exterior of a building.

Roof panels are subjected to frequent high uplift pressures during winds. When not securely fastened down, individual light roof panels can be torn loose and become flying missiles. Exterior wall panels, cladding and ornamental appendages may be subjected to severe positive or negative pressures. If the attachments are not adequate to resist the forces resulting from these pressures, such elements may also become flying missiles. Where such elements occur adjacent to a public way, they can be especially hazardous.

E. <u>Rating of Building Resistance to Tornado Hazards (FMD Form)</u>

Tornadoes, although having some statistical influence on the climatology records on which design winds speeds are based, pose special difficulties because of their short-time duration, small radial extent, and wide-range of maximum forces. The effective radial extent of a tornado may be less than a few hundred feet and is usually less than a mile. Tangential wind speeds of 200 miles per hour are probable. The pressure drop may be as much as 2 to 2.5 p.s.i. [3.3]. In the immediate path of a tornado, these wind pressures, both vertical and tangential can be devastating to certain types of buildings. Suction forces in the order of 400 lbs per square foot have been observed [3.3]. Obviously such uplift forces can pick up very heavy objects and pull a roof off a building.

Comments on the Use of FMD Rating Form

Damage from tornadoes has been most severe to small, light buildings; although, tall, flexible, and heavier buildings have sustained some severe structural damage. The most extensive damage to buildings has been to roofs and exterior cladding, including glass. This includes damage from wind blown debris. For the Field Evaluation Method, with the present state-of-the-art, a bad risk rating must be given to small, light buildings. A medium risk rating to small, heavy buildings, and to large, multi-story buildings that could be rated high in wind resistance or earthquake resistance. A good rating can only be given to heavy vault-like structures or structures known to have been designed for tornadoes under the criteria given by the Atomic Energy Commission. Very few buildings have actually been designed to resist tornadoes. Since 1967 the Atomic Energy Commission (AEC) has required designers of nuclear reactor facilities to carefully consider the effects of tornadoes on such facilities and have developed design criteria for this [3.4]. These criteria are very severe and would impose large additional costs on an average commercial building.

For the Field Evaluation Method considerable judgment must be exercised. For the building as a whole, the evaluation for wind is made on Form FMC. Tornado velocities can be much higher than other wind velocities but the capability of a building to resist high wind or hurricane velocities gives us some comparison. The "P_c" as determined for wind is used as a basis for tornado evaluation. The highest rating given based on the P_c comparison is "Fair." However, there are certain vault-like buildings which are inherently highly resistant to tornadoes. For the purpose of this method a vault-type building is defined as a building with a length-width ratio and a height-width ratio of two or less which has exterior walls of reinforced concrete or reinforced masonry and a reinforced poured-in-place concrete roof with not over 15% of the area of the walls or roof having openings.

The hazards from flying debris originating outside the facility can only be roughly evaluated. There are two sources of damage: one is from debris originating outside the building; the other is from elements of the building itself, such as broken glass, loose cladding, and appendages.

The path of a tornado cannot be predicted. The facility in question may be protected by surrounding structures but these surrounding structures themselves may have cladding or appendages which may be potential wind-blow missiles if a tornado moves through the area. In a lightly built-up area, the proximity of storage yards for such things as lumber, masonry units, and even automobiles may create a hazard for buildings. The DC Form includes a space for comment on the availability of loose material in the nearby area that could be airborne in a tornado and for obvious looseness of cladding or appendages on nearby buildings. Ratings for this type of hazard for the Field Evaluation Method can be given as large hazards or small hazards only. The data collectors will not be expected to survey all structures or all areas within, say, a quarter mile of the facilities.

The hazards from broken glass, loose appendages, or cladding originating in the building itself are similar to those discussed in wind evaluation, but the forces produced by tornadoes can be much greater. The criteria set up for anchorage of appendages and cladding will not protect from tornadoes. Neither will the criteria for wind set up for glass, glazing, and window frame anchorage. Localized pressures of over 250 p.s.f. positive or negative may occur in tornadoes and this will break most glass or blow it out or in.

The FMD Form has a space for noting the availability of basements for emergency storm shelters. Since tornadoes move laterally up to, say, 60 miles per hour, the duration of use for such a shelter is short. The form merely notes the presence or absence of such a basement and the capacity based on 15 square feet per person. Basements of buildings having heavy concrete ground floor slabs are potentially good emergency storm shelters for tornadoes. This is true even if the superstructure is heavily damaged. The DC Form has spaces for noting this information. The basement should be dry and not contain hazardous equipment such as those in a transformer vault or highly flamable materials in large quantities.

F. Resume of Ratings - Structural Systems - Capacity Ratios (FME Form)

Form FME takes data from Forms FMA-1, FMA-2 and FMC-1 to determine "Capacity Ratios." The "General Rating" for earthquake is weighted with "Sub-Rating (SRI)" and "Sub-Rating (SR2)" to arrive at the "Basic Structural Rating."

Reference is made on Form FME to the Modified Mercalli Scale. This scale is a measure of ground motion intensity at a particular location. Other scales have been used or are being proposed. However, the Modified Mercalli Scale is the most commonly used at the present time. Table 2.1 presents a summary of the Modified Mercalli Intensity Scale (MMI). On Form FME the relation of Intensity Level Factors to Modified Mercalli Scale is based on judgment and interpretation of the Modified Mercalli Scale. The "Basic Structrual Rating" is compared to the "Intensity Level Factor" to obtain the "Capacity Ratio" for earthquakes. The "Capacity Ratio" for wind is taken directly from FMC-1. For capacity ratios greater than 1.5 on important buildings, an evaluation using either the Approximate or Detailed Analytical Method should be made.

Table 2.1 should be used to select MMI intensity. The reader may find it helpful for his particular region of the United States to relate UBC Seismic Risk Zone ratings with general MMI intensity levels. Figure 2.3 and table 3.3 should assist in such a characterization.

Table 3.3 UBC SEISMIC RISK ZONES AND MMI INTENSITIES

UBC Seismic Risk Zone (see Figure 2.3)	Modified Mercalli Intensity (MMI)
0	below V, no damage
1	V and VI, minor damage
2	VII, moderate damage
3	VIII or higher, major damage

3.3 APPROXIMATE ANALYTICAL EVALUATION METHOD

A. Introduction

The approximate analytical procedures are developed in this section. The capability of an existing building to resist natural hazards is evaluated by determining stress ratios of critical structural and nonstructural elements. These stress ratios are the ratios of the stresses produced by the loading to limiting stresses of the critical building elements. This method can be used only when plans and personnel capable of making structural calculations are available. If original calculations are available, the method becomes a checking procedure. If not, new calculations must be made. The procedures for calculations are described later in this section. This method gives more accurate results than the Field Evaluation Method. It can usually be done by hand calculation, although computer programs may be used if available. The Approximate Analytical Evaluation Method in general, does not include the use of a dynamic analysis except in special cases.

B. Rating of Building for Resistance to Earthquake Hazards

Information Necessary for the Method

The establishment of the seismicity for any given site will be selected by the user. This seismicity may be determined in several different ways. If they can be obtained, the recurrence rate and probability of occurrence at the site for earthquakes originating along various faults at varying distances from the site should be taken into consideration to establish the appropriate level of seismic motions. The seismicity factor may be simply that specified on macrozoned maps, it may be determined from an assumed site earthquake intensity, or by one of several methods as described later.

It is assumed that detailed construction plans are available for review and that these plans have been verified roughly by a field team and that the Data Collection Form, see Appendix A, has been completed. This field verification will show whether additions or major changes have been made since the plans were produced. If changes have been made, plans showing these changes should be obtained to show the "as-built" conditions.

If possible, the original structural calculations should be obtained. In areas where seismic design is required by governmental authorities, such calculations will be of valuable assistance in the evaluation of the earthquake hazard. In other areas where there are no seismic requirements, calculations may cover only vertical load design,or possibly vertical load plus wind. Even these will aid in the evaluation.

A soils report may be available giving recommended bearing pressures, or pile capacities. If such a report is not available,the adequacy of the foundation design may be roughly estimated by the test of time. Thus, if the building shows no evidence of settlement damage over a period of several years and has been subjected to probable weather hazards, the foundation design criteria originally used was probably adequate, at least for vertical loads. If there is evidence of settlement, which usually shows up in diagonal cracks in walls or partitions, the foundation design criteria will be questionable and additional data should be obtained. If no foundation, or soil report is available, information possibly may be obtained from soils investigation of adjoining properties, or from the local building officials.

Criteria for the Method

The criteria used for the Approximate Analytical Evaluation Method will be an appropriate building code. Any building code containing compatible load and resistance functions may be used. However, the explicit code used herein will be the 1973 Edition of the Uniform Building Code [2.5]. Specifically, Chapter 23 of the code relating to earthquake design and Chapters 24, 25, 26, 27 and 28 giving allowable working stresses and design criteria for masonry, timber, concrete, steel and iron, and aluminum respectively.

Limitations of the Method

A more complex type of evaluation called Detailed Analytical Evaluation Method is given in section 3.4. In that method the seismicity of the particular area will be determined using a predetermined base rock motion modified by the dynamic amplification of the soil. The surface ground motion will be found in terms of maximum velocity, acceleration, and displacement. From this, elastic spectral response curves for single degree of freedom masses are derived and plotted. Modified spectra are developed for the effects of variations in damping and inelastic behavior. Thus, if the dynamic characteristics of the structure are known (including the damping) the acceleration, velocity and displacement of each mode can be determined.

For multi-degree of freedom systems, the participation of each mode is determined and these are superimposed to arrive at the building response. In the Approximate Analytical Evaluation Method, these types of dynamic analyses, in general, will not be used. However, if the site data are available, say from a complete analysis of an adjoining building, a procedure is provided in the Approximate Analytical Evaluation Method to make use of this information for site seismicity. Also, the mode shapes of the building may be needed if the building is highly irregular in the mass to stiffness ratios of adjoining stories as described later.

Base shears as computed using 1973 UBC [2.5] specified values in the various zones are less than would be determined by the more explicit dynamic methods but is compensated for by the use of working stresses in material resistances. Dynamic response of a structure has been simulated in the 1973 UBC by the use of a triangular distribution of base shears and by varying these base shears with the natural period of the building. Experience has shown that most buildings designed by UBC criteria have come through earthquakes satisfactorily. The philosophy in seismic design is expressed by the Structural Engineers Association of California (SEAOC) in their recommendations that structures designed in conformance with the provisions and principles set forth in the SEAOC Code [3.6] (incorporated in the UBC seismic design criteria) should be able to:

- Resist minor earthquakes without damage.
- Resist moderate earthquakes without structural damage but with some non structural damage.
- Resist major earthquakes of the intensity or severity of the strongest experienced in California, without collapse, but with some structural damage as well as non structural damage.

The 1973 UBC criteria does not include an explicit parameter for the influence of the supporting soils in the base shear formula. In the formula $C = \frac{.05}{\sqrt[3]{T}}$,((14-2) on page 128 of 1973 UBC), arbitrary methods of computing T are permitted to be used or "properly substantiated technical data may be submitted." In Formula (14-1) on the same page of 1973 UBC, V = ZKCW, the selection of values for K recognize variations in response of different types of buildings and lateral force resistant systems. These are judgment factors reflecting experience and evaluation of the performance of structures in major and moderate earthquakes.

The distribution of forces throughout the height of the structure is primarily a triangular distribution of forces which approaches the dynamic response of uniform multi-degree of freedom systems. Deviations from this distribution for very flexible type buildings are recognized by the inclusion of a portion of the base shear as a special force applied to the top level designated F_t.

There are computer programs for checking moment-resistant frames for lateral forces. If it is not desired to use such a computer check there are several hand calculation methods frequently used. The Structural Engineering Handbook by Gaylord and Gaylord, 1968 Edition, [3.7] describes such methods as the portal method and the cantilever method in which the relative stiffness of columns and girders is disregarded. The more accurate moment distribution method is also mentioned. In this book reference is also made to the Spurr, Goldberg, and Grinter methods which add certain refinements. Another reference is the Theory of Modern Steel Structures, Volume II, Chapter 6, by Grinter, [3.8] which gives several methods for analyzing rigid frames subjected to lateral forces. The method most consistent with the degree of accuracy required for the facility being investigated should be used.

The earthquake effects on a structure that are evaluated using the Approximate Analytical Evaluation Method procedures are those resulting from shaking. Not evaluated are the earthquake effects which produce foundation settlements or failures, ground lurching or liquefaction, surface trace of earth faulting, failure of the slope beneath the structure, tsunamis, seiches, or inundation resulting from dam or reservoir failure.

Commentary on Setbacks and Dynamic Irregularities

Forces on irregular structures are covered in 2314(d)1 on page 128 of 1973 UBC in Exception 2 to Equation 14-2 as follows:

> "Buildings or structures which have highly irregular shapes, large differences in lateral resistance or stiffness between different stories or other unusual structural features affecting seismic response shall be designed for forces which their dynamic properties induce.

Setbacks are covered in 2314(i), page 130 of the same code and states:

> "Buildings having setbacks wherein the plan dimension of the tower in each direction is at least 75 percent of the corresponding plan dimension of the lower part may be considered as a uniform building without setbacks for the purpose of determining seismic forces."

> "For other conditions of setbacks the tower shall be designed as a separate building using the larger of the seismic coefficients at the base of the tower determined by considering the tower as either a separate building for its own height or as part of the overall structure. The resulting total shear from the tower shall be applied at the top of the lower part of the building which shall be otherwise considered separately for its own height.
>
> > EXCEPTION: Nothing in this subsection shall be deemed to prohibit the submission of properly substantiated technical data for establishing the lateral design forces by a dynamic analysis."

For the purpose of this evaluation, at least the first three mode shapes and periods for irregular buildings over two stories are required to be determined. The first step is to determine the mass and stiffness associated with each story. Next, the periods and mode shapes are determined using standard equations and procedures. This step can be very difficult and time-consuming to perform by the hand methods. Computer solutions, see section 3.4E or [3.9], are readily available and should be used. Modal participation factors can be determined after the mode shapes are known. These frequently are part of the computer program, but can be easily done by hand. Using this information and the prescribed base shear from the code, the shear distribution of the lateral forces can be determined.

Commentary on Diaphragms

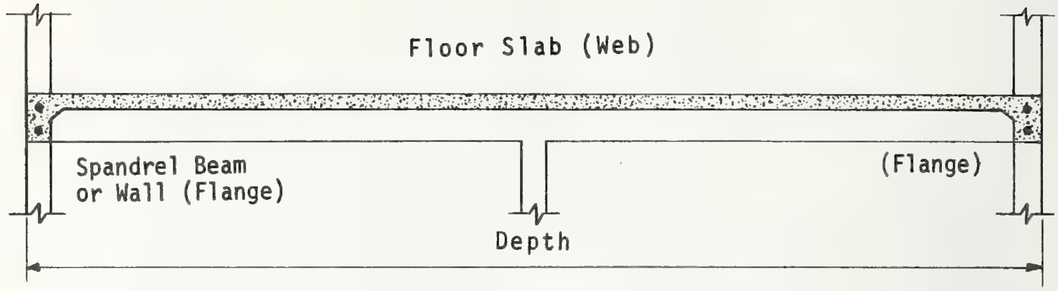
Floor and roof systems can function as diaphragms to distribute horizontal forces to vertical resisting elements. These functional characteristics are discussed in the Tri-Service Manual "Seismic Design for Buildings" [3.1, section 2]. Portions of this are presented here to illustrate items to be considered in analysis of diaphragms.

"2-04. DIAPHRAGMS: Horizontal forces at any floor or roof level may be distributed to the vertical resisting elements by using the strength and rigidity of the floor or roof deck as a diaphragm. A diaphragm may be considered analogous to a plate girder laid in a horizontal (or inclined in the case of a roof) plane where the floor or roof deck performs the function of the plate girder web, the joints or beams function as web stiffners, and the peripheral beams or integral reinforcement function as flanges. A diaphragm may be constructed of materials such as concrete, wood, or metal in various forms. Combinations of materials are possible. Working stresses for such materials as cast-in-place reinforced concrete and structural steel are well-known and present no problem to the designer once the loading and reaction system is known. Other materials frequently used to support vertical loads in floors or roofs have well established vertical load characteristics but have required tests to demonstrate their ability to resist lateral forces. Various types of wood sheathing and steel decks fall in this category. Where a diaphragm is made up of units such a plywood, precast concrete floor units or steel deck units, its characteristics are, to a large degree, dependent upon the attachments of one unit to another and to the supporting members (see figure 3.6).

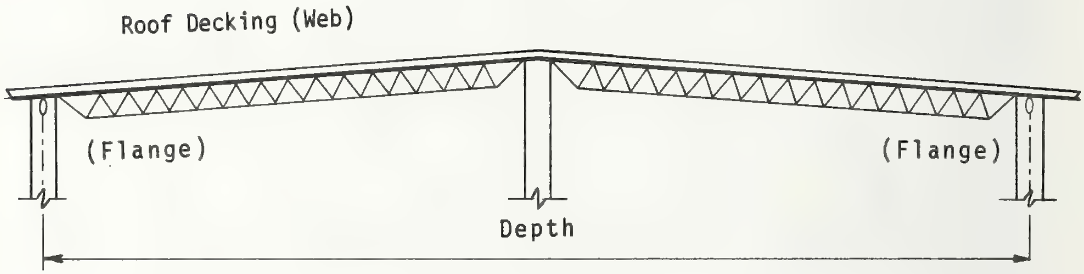
a. Seismic Loadings. Floors and roofs used as diaphragms will be designed for a lateral force of $F_p = ZC_pW_p$ acting in any direction unless a greater force is required by the basic seismic formula V = ZKCW (see figure 3.7).

b. Distribution of Seismic Forces. The total shear (F_p or V) at any level will be distributed to the various vertical elements of the lateral force resisting system (shear walls or moment-resisting frames) in proportion to their rigidities considering the rigidity of the diaphragm. The effect of diaphragm stiffness on the distribution of lateral forces is discussed and schematically illustrated in figure 3.4. For this purpose, diaphragms are classified into four groups of relative flexibilities. These are rigid, semi-rigid, semi-flexible and flexible diaphragms. No diaphragm is actually infinitely rigid and no diaphragm capable of carrying a load is infinitely flexible.

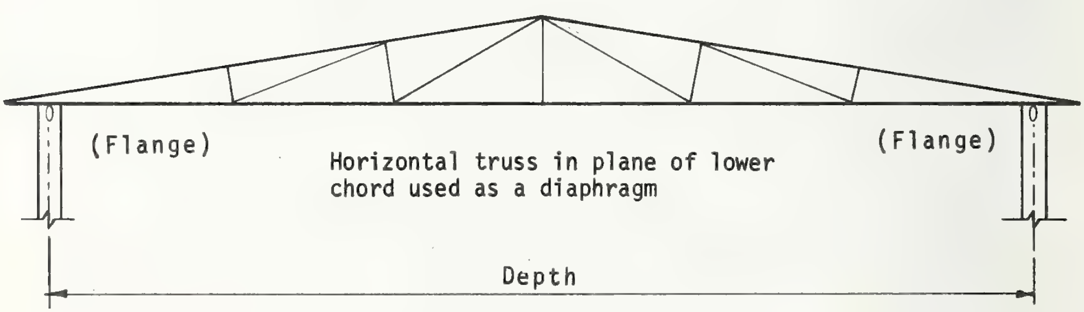
(1). A rigid diaphragm is assumed to distribute horizontal forces to the vertical resisting elements in proportion to their relative rigidities. In other words, under symmetrical loading a rigid diaphragm will cause each vertical element to deflect an equal amount with the result that a vertical element with a high relative rigidity will resist a greater proportion of the lateral force than an element with a lower rigidity factor.



FLOOR SLAB DIAPHRAGM

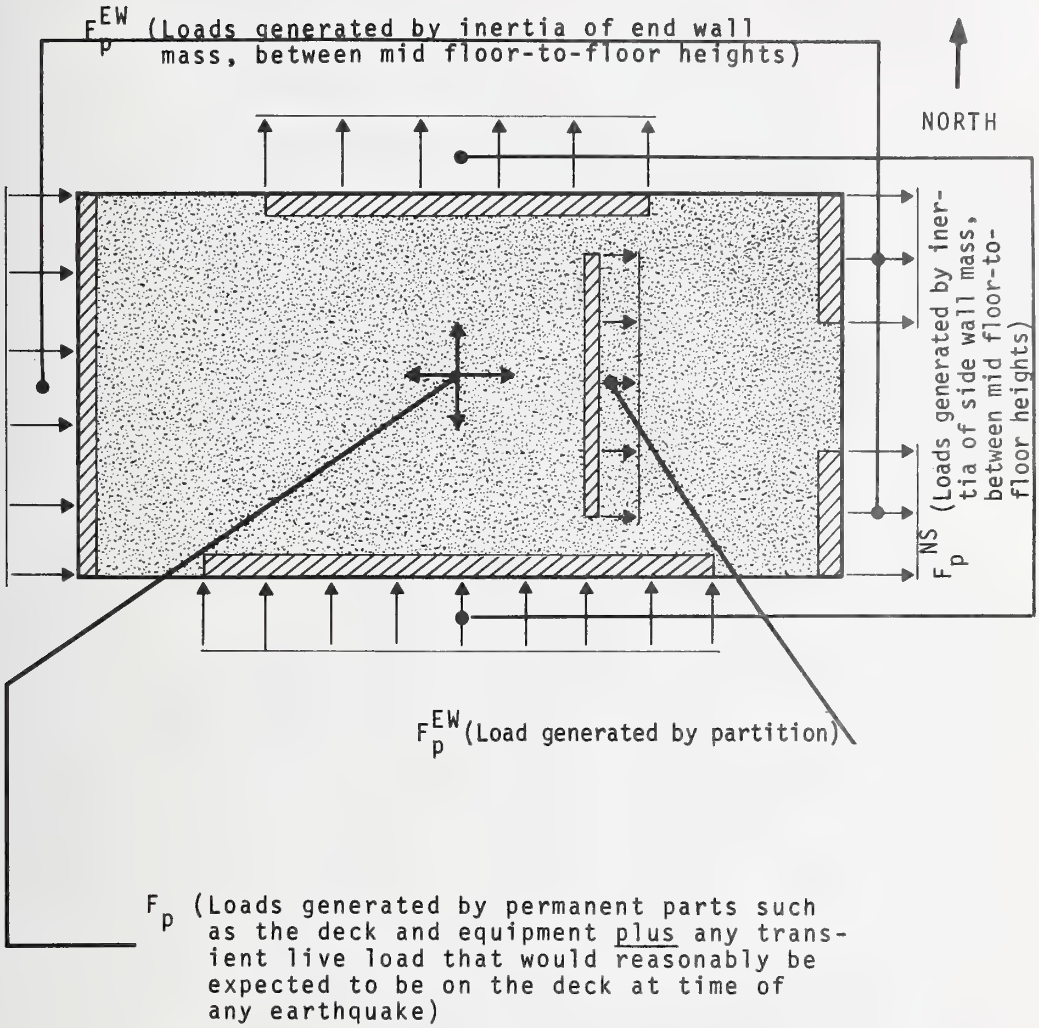


ROOF DECK DIAPHRAGM



TRUSS DIAPHRAGM

Figure 3.6 Structural Diaphragms



*NOTE: Generally, it is assumed that the in-plane mass of a shear wall does not contribute to the diaphragm loading unless the shear wall is interrupted at the specific level. In case a shear wall does not extend below the floor level, both its horizontal and vertical loads must be distributed to the remaining walls. Of course, major differences in rigidities may be cause for redistribution.

Figure 3.7 Diaphragm Loading

(2). A flexible diaphragm is analogous to a shear deflecting continuous beam or series of beams spanning between supports. The supports are considered non-yielding as the relative stiffness of the vertical resisting elements compared to that of the diaphragm is great. Thus a flexible diaphragm will be considered to distribute the lateral forces to the vertical resisting elements on a tributary load basis. A flexible diaphragm will not be considered capable of distributing torsional stresses resulting from concrete or masonry masses.

(3). Semi-rigid and semi-flexible diaphragms are those which have significant deflection under load but which also have sufficient stiffness to distribute a portion of their load to vertical elements in proportion to the rigidities of the vertical resisting elements. The action is analogous to a continuous concrete beam system of appreciable stiffness on yielding supports. The support reactions are dependent on the vertical elements. A rigorous analysis is sometimes very time-consuming and frequently unjustified by the results; at best, the results are no better than the assumptions that must be made. In such cases a design based on reasonable limits may be used; however, the calculations must reasonably bracket the likely range of reactions and deflections.

(4). Torsional moment is generated whenever the center of gravity (cg) of the lateral forces fails to coincide with the center of rigidity (cr) of the vertical resisting elements, providing the diaphragm is sufficiently rigid to transfer torsion. The magnitude of the torsional moment that is required to be distributed to the vertical resisting elements by a diaphragm is determined by the sum of the moments created by the physical eccentricity of the translational forces at the level of the diaphragm from the center of rigidity of the resisting elements ($M_T = F_p e$, where e = distance between cg and cr) and the "accidental" torsion of 5%. The "accidental" torsion is an arbitrary code requirement equivalent to the story shear action with an eccentricity of not less than 5% of the maximum building dimension at that level. The torsional distribution by the more rigid diaphragms to the resisting elements will be assumed to be in proportion to the stiffness of the elements and its distance from the center of rigidity. Negative torsional shears will be neglected. The more flexible diaphragms will not distribute torsional shears. Cantilever diaphragms on the other hand will distribute translational forces to vertical resisting elements, even if the diaphragm is flexible. In this case, the diaphragm and its chord act as a flexural beam on supports (vertical resisting elements) whose resistance is in the same direction as the forces, see figure 3.8.

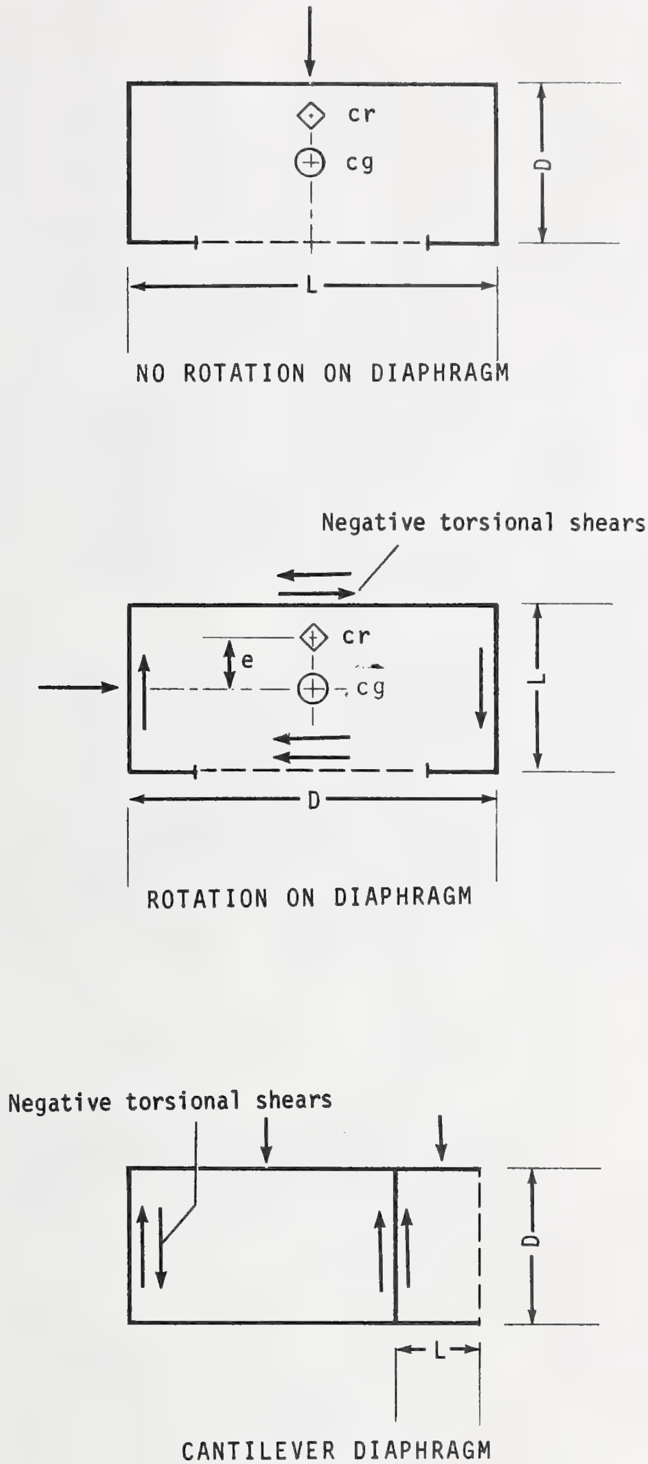


Figure 3.8 Torsional Force Considerations

c. Diaphragm Deflections. A diaphragm should be capable of providing such stiffness and strength so that walls and other vertical elements laterally supported by the diaphragm can safely sustain the stresses induced by the response to seismic motion. The total computed deflection (Δ_d) of the diaphragms under the prescribed static seismic forces consists of the sum of two components. The first component is the flexural deflection (Δ_f) of the diaphragm which is determined in the same manner as the deflection of beams. The assumption that flexural stresses on the diaphragm web are neglected will be used except for reinforced concrete slabs. For such slabs the proportional flexural stresses also may be assumed to be carried by the web. The second component is the web deflection (Δ_w) of the diaphragm. The specific nature of the web deflection will vary depending on the type of diaphragm. The deflection of the diaphragm under the prescribed static forces will be used as the criteria for the adequacy of the stiffness of a diaphragm. The limitation on deflection is the allowable amount prescribed for the relative deflection (drift) of the walls between the level of the diaphragm and the floor below. In design a limitation imposed on diaphragms supporting flexible walls is a maximum span-to-depth ratio, see table 3.4.

d. Flexibility Limitations. The determination and limitations of the deflections of a diaphragm is a design function. The deflections of some diaphragms can be computed with reasonable accuracy. However, other diaphragms have characteristic and fabrication variables making an accurate solution of deflection characteristics meaningless. Thus the methods of determination of the deflection characteristics for diaphragms of all materials given herein will be used to keep the range of diaphragm deflections within reasonable limits. In order to provide a means of properly classifying and identifying the stiffness of a diaphragm web, the factor "F" will be introduced.

$$F = \frac{\Delta_w \times 10^6}{q_{ave} L_1} \qquad (3.3.1)$$

where:

L_1 = Distance in ft. between vertical resisting element (such as shear wall) and the point to which the deflection is to be determined.

q_{ave} = Average shear in diaphragm in pounds per ft. over length L_1.

Δ_w = Web component of Δ_d.

Table 3.4 FLEXIBILITY LIMITATION ON DIAPHRAGMS

FLEXIBILITY CATEGORY	F (see eq. 3.3.1)	MAXIMUM SPAN (feet)	SPAN/DEPTH LIMITATIONS			
			No Torsion In Diaphragm[3]		Torsion in Diaphragm[2]	
			Brittle Walls[1]	Flexible Walls	Brittle Walls[1]	Flexible Walls
Flexible	Over 70	100	2:1	3:1	Not used	2:1
Semi-Flex.	10-- 70	200	2 1/2:1	4:1	Not used	2 1/2:1
Semi-Rigid	1-- 10	300	3:1	5:1	2:1	3:1
Rigid	Less than 1	400	Deflection Reqm't Only	No Limitation	Deflection Reqm't Only	3 1/2:1

Notes:

1. Walls in concrete and unit-masonry are classified as brittle; in all cases, check allowable drift before selecting type of diaphragm.

2. When applying these limitations to cantilever diaphragm , the span/depth ratio shall be limited to one-half that shown.

3. No torsion in diaphragm other than the 5% "accidental" torsion required by SEAOC Code.

Conversely, the web deflection will be determined by the equation

$$\Delta_w = \frac{q_{ave} L_1 F}{10^6} \tag{3.3.2}$$

Using the factor F, the flexibility categories of diaphragm webs have designated values as prescribed in table 3.4. The span-depth limitations do not directly reflect deflections. But, if the diaphragm is designed within the proper ratio, the deflection requirements will be considered to be met unless an unusual building layout is used wherein deflection criteria would become critical.

Floor and roof diaphragms may be of poured-in-place concrete, wood with diagonal or plywood sheathing, metal decks with or without structural concrete topping, precast concrete units a poured-in-place topping and, in the case of roofs, a cast-in-place gypsum deck. Horizontal steel bracing systems are sometimes used. These are commented on in the next few paragraphs. Design examples of these can be found in the Tri-Service Manual [3.1].

Poured-in-place concrete floors or roofs can be analyzed in accordance with Chapter 26 of UBC. Flexural stresses in the diaphragm resisted by chord elements should be analyzed. For instance, in a rectangular building where the vertical resisting elements are in the exterior walls, there may be concrete beams acting as supports for vertical loads, plus functioning concurrently as a horizontal diaphragm chord. The reinforcing steel stress should be checked for the combination of these two functions. Reinforcement around openings in concrete diaphragms should be checked for adequacy to carry diaphragm shears and bending moments. Minor holes frequently can be ignored in their effect on diaphragm capacity.

Where a stairwell is adjacent to a shear wall, the interface between diaphragm slab and shear wall is reduced in length and should be checked for shear. The transfer of forces from the concrete diaphragm to interior shear walls or vertical bracing elements walls should be checked. Special tie-struts developed into such shear walls and diaphragms are sometimes required for this transfer.

Where a vertical resisting element occurs in an upper story but is not present in the same location in the story below, the diaphragm must be able to transfer the horizontal force from the upper element to a lower element in another plan location.

For wood diaphragms the allowable stresses and shape limitations of various types are given in paragraph 5-07 of the Tri-Service Manual and in Section 2514 of the 1973 UBC.

There are many types of metal deck diaphragms. There are different configurations, gauges and fastening patterns. Allowable stresses in metal decks acting as diaphragms have generally been determined by tests and special approvals have been given for most of the commonly used decks by building code authorities based on these tests. In most cases the deck manufacturer has published the diaphragm shears approved by such agencies. The governing building agency for the area involved may be contacted for such values or special approvals [3.10]. For example, the International Conference of Building Officials (ICBO) will furnish these on request [3.10]. Formulas for computing metal deck diaphragm shear values may be found in paragraph 5-06 of the Tri-Service Manual. Metal decks with concrete topping slabs are also covered therein.

Precast concrete floor diaphragms units such as concrete plank, concrete tees or double tees are frequently used as floor construction. The diaphragm resistance of such units depends on the connections between units and their supporting elements and the connections to the diaphragm strut and tie elements, where no structural topping slab is used. Some tests have been made on such assemblies with considerable variations in attachment technique. These can be verified with the fabricator and usually confirmed with the governing code agency in the area involved. (ICBO will do this on request.) [3.10] Where a structural cast-in-place concrete topping is used, such concrete topping may be considered as a diaphragm slab provided it is reinforced with steel qualifying at least as temperature reinforcement.

Shear values for cast-in-place gypsum diaphragms are given in Paragraph 5-05 of the Tri-Service Manual or in the UBC Standards [2.5]. Typical details of this type of construction are also shown in the Tri-Service Manual on Plate 5-5-1.

Steel horizontal bracing systems may be analyzed as a truss. It may be continuous over several supports. Care should be taken that horizontal forces are delivered to vertical resisting elements at truss bracing panel points.

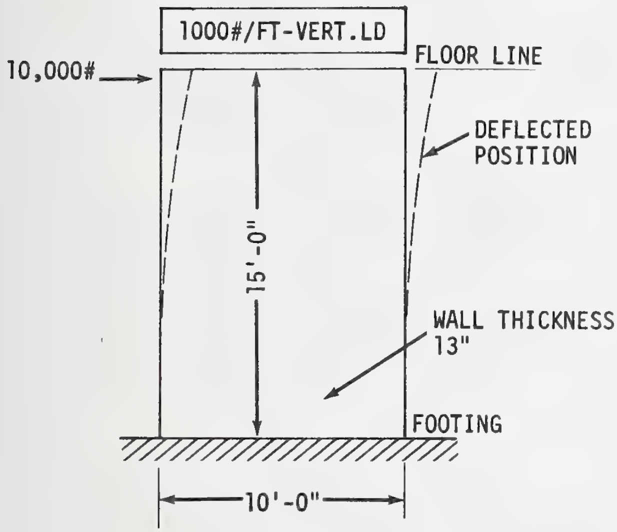
Commentary on Masonry or Concrete Walls

In computing the relative stiffness for analyzing the distribution of shears to vertical resisting elements, masonry or concrete walls (whether infill walls, curtain walls, or bearing walls) must not be ignored. Some buildings have been designed without considering masonry or concrete filler walls, assuming all lateral resistance to be supplied by the structural frame. This will not happen until the filler walls are severely damaged. All masonry or concrete walls should be checked to assure stresses will not exceed the allowable design stress, see figure 3.9. Where such walls are not isolated but are bounded by elements of the structural frame, they must deflect with the structural frame. In so doing, they assume a portion of the total resistance to lateral forces. This portion may be a relatively high percentage depending on the size and location of such walls. The difference between the lateral force resisting behavior of a structural frame and the combination of a structural frame and infill wall is illustrated in figure 3.10. Test results [3.62] indicate the drastic difference between the behavior of frames without filler walls and those with filler walls. Frames with filler walls were considerably stronger and stiffer than frames without walls. They were also much less ductile. The tests by Fiorato et. al.[3.62] also describe the influence of frame reinforcement, size, shape and location of wall openings, etc. on the behavior of frames with filler walls. Thus, when the walls are not considered in the design, the entire distribution of resistance to lateral forces may be different than that assumed.

Methods for computing the deflections of concrete and masonry walls, including a design aid chart, are shown in Section 6 of the Tri-Service Manual, a portion of which follows for ease of reference [3.1].

SAMPLE COMPUTATION - UNREINFORCED BRICK WALLS

ASSUME SOLID BRICK MASONRY - 4500 PSI
TYPE M OR S MORTAR
INSPECTED
ASSUME ALLOWABLE SHEAR OR TENSION IS 20 PSI



HORIZONTAL LOAD IN PLANE OF WALL

CHECK UNIT SHEAR

$$\frac{10000}{10 \times 12 \times 13} = 6.5 \text{ PSI}$$

CHECK OVERTURNING

$$M = 10000 \times 15 = 150000'\#$$

$$S = \frac{13 \times 120^2}{6} = 31.200$$

$$M = \frac{150000 \times 12}{31{,}200} = 57.5 \text{ PSI}$$

VERTICAL LOAD = 1000# COMPRESSION
+ 15 x 130 = 1950
29501 PER LIN FT.

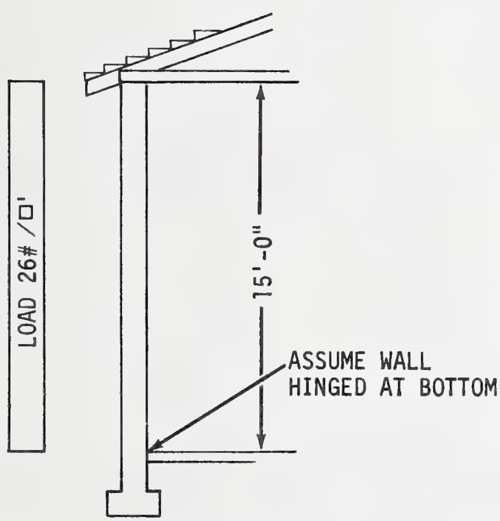
$$= \frac{2950}{156} = 18.8 \text{ PSI}$$

MAXIMUM COMPRESSION =

57.5
+18.8
76.3 PSI (COMPLIES)

MAXIMUM TENSION =

57.5
-18.8
38.7 PSI (DOESN'T COMPLY)



HORIZONTAL LOAD NORMAL TO WALL

$$M = \frac{26 \times 15^2}{8} = 730'\#/\text{LIN. FT.}$$

$$S \text{ PER LIN. FT.} = \frac{12 \times 13^2}{6} = 338$$

$$\frac{M}{S} = \frac{730 \times 12}{338} = 26 \text{ PSI}$$

$$\text{VERT. LD} = \frac{1000}{156} = -\ 6.4 \text{ PSI}$$

19.6 PSI NET TENSION (COMPLIES)

Figure 3.9 Sample Computation - Unreinforced Brick Walls

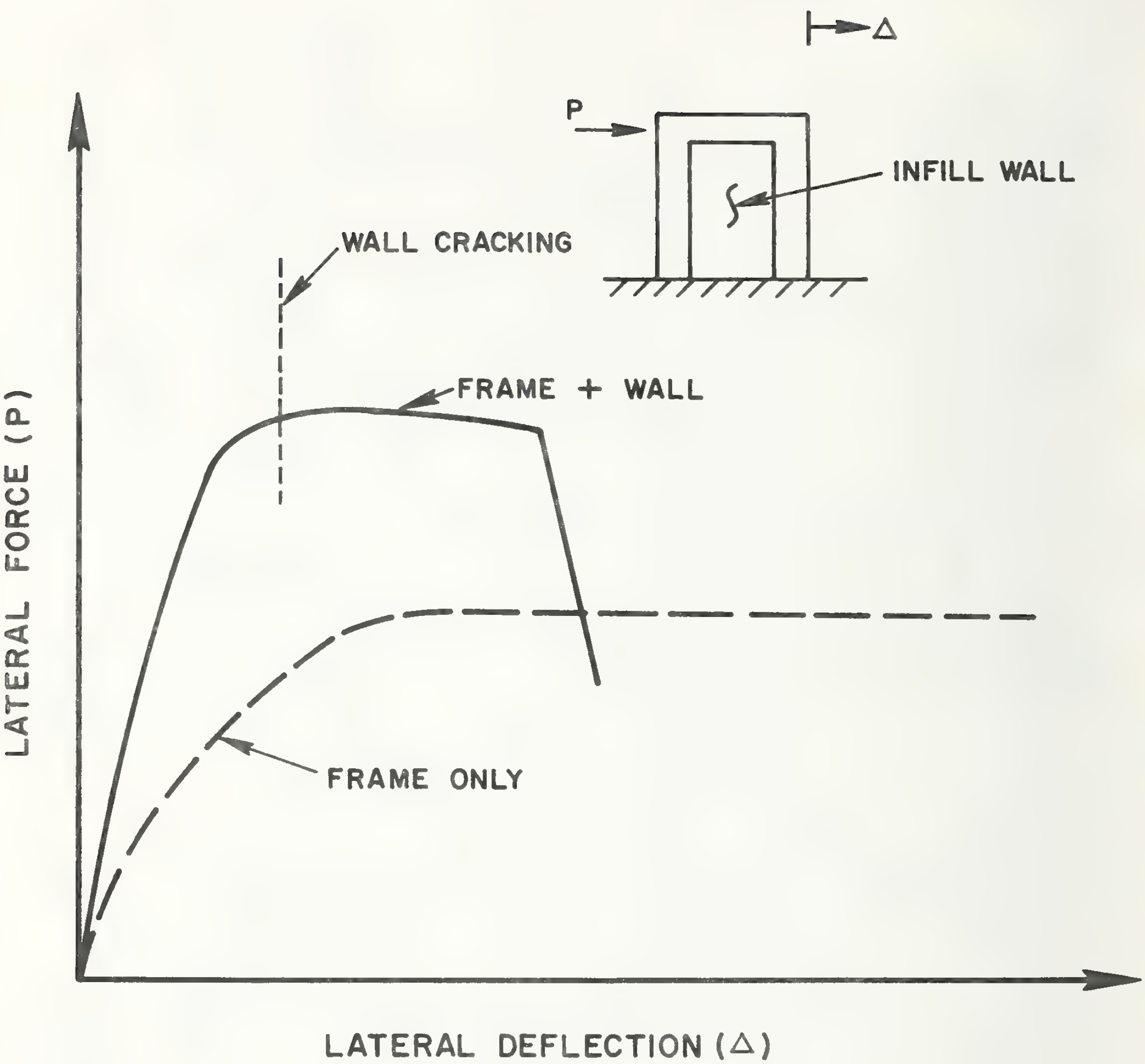


Figure 3.10 General Infill Wall-Frame Force Deflection Characteristics

CONCRETE AND MASONRY SHEAR WALLS:

a. Wall Deflections. The deflection of a concrete shear wall can be determined from the sum of the shear and moment deflections. In the case of a solid wall with no openings the computations of deflection is quite simple. However, where the shear wall has openings in it, as for doors and windows, the computations for deflection and rigidity are much more complex. An exact analysis considering angular rotation of elements, rib shortening, etc., is very time consuming. For this reason, several short-cut approximate methods involving more or less valid assumptions have been developed. These do not always give consistent or satisfactory results.

b. Shear Distribution. Where several independent shear walls are reacting forces from a rigid diaphragm in any one-story structure, the relative rigidity of the various walls must be determined. This is necessary so that a logical and consistent distribution of story shears to each wall can be made. The total height of wall from diaphragm level above to diaphragm or foundation level below frequently must be considered. Exact determination of stiffness is very difficult and not necessary. Approximate methods in which the deflections of portions of walls are combined usually are adequate.

c. Deflection Charts. Figure 3.11 shows deflection charts for concrete or masonry shear walls and piers. Curves 1 and 2 are for shear deflection only. Curve 1 is for shear deflection of a corner pier or pier with flanges and Curve 2 for a rectangular pier. Curves 3 and 4 are for fixed-ended corner and rectangular piers. Curves 5 and 6 are for cantilever corner and rectangular piers. The corner pier curves are for the special case where the I of the corner pier is 1.5 times the I of a rectangular pier. For other I values the bending portion of the deflection would be proportional. The deflection shown on the charts are for a horizontal load of P of 1,000,000 pounds. The deflections shown on the charts are reasonably accurate. The formulas written on the curves can be used to check the results. However, the charts will give no better results than the assumptions made in the shear wall analysis. For instance, the point of contraflexure of a vertical pier may not be in the center of the pier height. In some cases the point of contraflexure may be selected by judgment and an interpolation made between the cantilever and fixed conditions."

The rigidity is the inverse of deflection. Figure 3.11 also provides an approximate method for checking possible damage to infill walls. Assume that the story drift has been computed. Then enter the chart and find the load which would produce this drift in the type and shape of wall being checked. If this load would produce stresses in the wall in excess of twice the allowable working stresses, then the wall should be considered to be critically stressed.

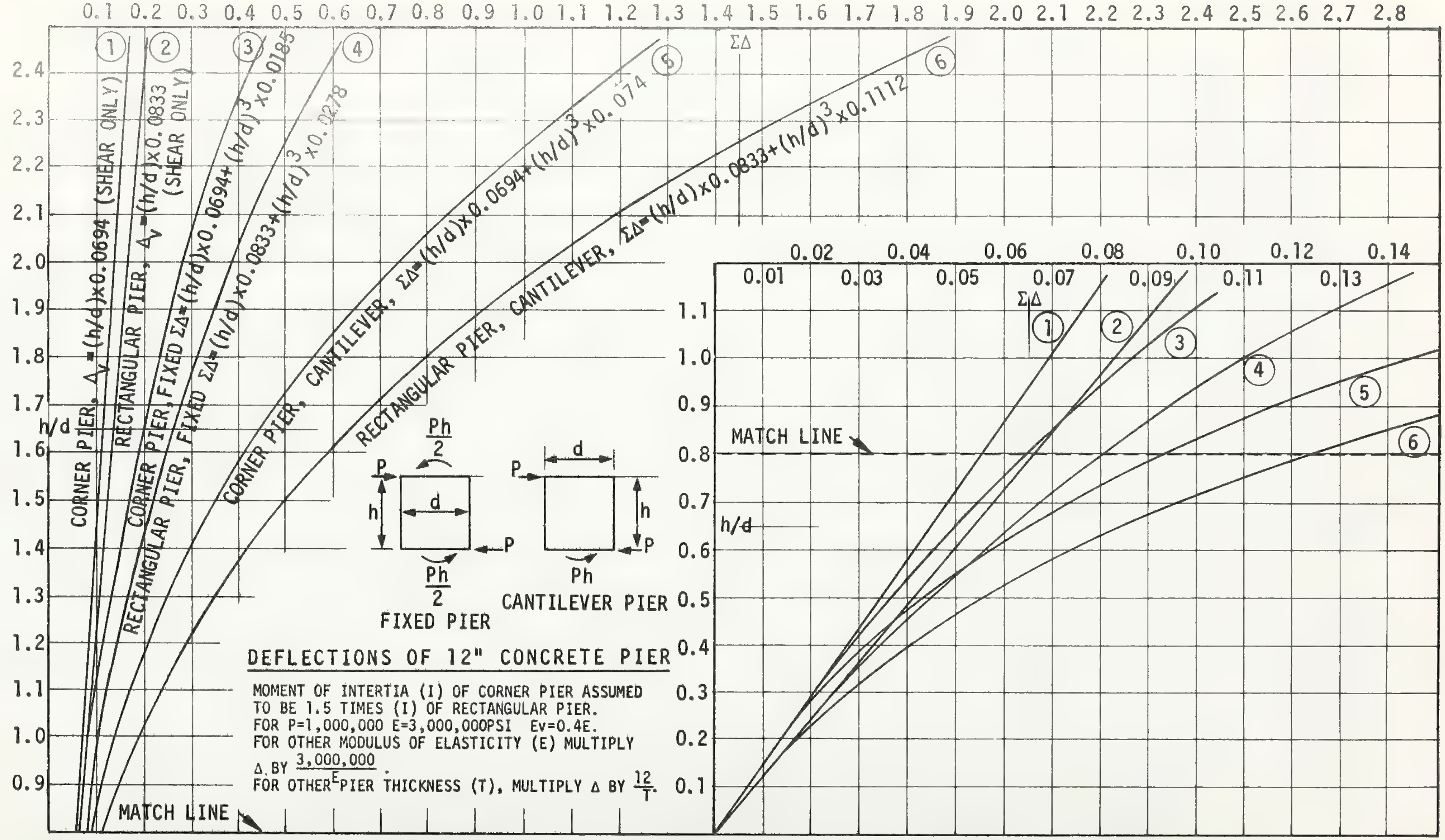


Figure 3.11 Design Curve for Masonry and Concrete Shear Walls

Effect of Damaged Elements on Evaluation

If the Data Collection Form indicates damage to a particular element of the lateral force resisting system, it should be reviewed in the field and the degree of damage assessed. The percentage of its rigidity and its capacity to resist forces should be estimated and these modified values used in the calculations.

Determination of Critical Elements

Any important earthquake resisting element having the highest unit stress as related to allowable design stresses is a critical element to be considered in the evaluation of the structural system. The term "important" element means an element which, if it failed, would seriously reduce the capacity of the structure as a whole to resist lateral forces. Some members would not be critical when deformed beyond their yield level deformations. In other members, yielding may cause an important redistribution of loads. With a multiplicity of well-distributed similar elements, the redistribution of loads would add only a small percentage of stress to adjoining or parallel elements. In a shear wall building, for instance, if a pier in a wall is highly overstressed and its force redistributed to the remaining piers without overstressing them, then the pier in question would not be a critical element. For another example, assume a large multi-story structure supported on only four columns. The failure of one of these columns could cause collapse and, in such cases, the evaluation of such columns and top and bottom connections should be viewed with special conservatism.

In most buildings the critical elements will be the vertical resisting elements (shear walls or moment resistant frames) and the horizontal resisting elements (diaphragms). This is for earthquake forces acting in the plane of the elements. Earthquake forces normal to a wall are a function of the weight of the wall itself. Where a wall has a long span between floor diaphragms or vertical frame elements it might be a critical element if its failure would produce collapse of the building as a whole from vertical loads or in plane lateral forces. Good engineering judgment in selection of critical elements may save considerable checking time. If original calculations are available, stress ratios taken from these calculations are useful in determining the most critical elements even though the original design criteria may be different from the criteria for which it is being checked.

Determination of Critical Stress Ratios

The highest ratio of stress resulting from the required seismic forces (f_e) to the allowable material design stress (f_a) (including 1/3 increase where permitted but deducting capacity required by gravity loads) on any critical element is termed the critical stress ratio $\frac{f_e}{f_a}$. The critical stress ratio is the indicator for evaluating the seismic resisting capability of the structure. Load factors and ultimate capacities are used for concrete design and for plastic design of structural steel.

Site Seismicity for the Method

Several choices are available for the determination of the site seismicity. The simplest is to use figures 1, 2, or 3 on pages 131 and 132 of UBC [2.5], or similar zoning maps which specify the seismicity by designating broad zones in which the value of Z in the base shear formula V = ZKCW is specified. If the maximum Modified Mercalli Intensity (MMI) is specified or determined by others for the site, the Z factor (Z_s) can be determined using the equation "$2 \log 5Z_s = -1.973 + .375$ MMI" where Z_s shall not be greater than 2.0. This equation is not based on derivation but an empirical relationship constructed for this project from the data in Ref. 3.20. The equation produces Z_s values which are consistent with past experience in relating the general effects of various Modified Mercalli Intensity ratings to observed response of buildings having varying design resistances. It is given in the form so that data developed by the methods covered in section 3.4 may also be used for the Approximate Analytical Evaluation Method of the building. Empirically it is found that a good relationship between Z_s and V_s is $25Z_s^2 = V_s$ in which V_s is the soil particle velocity as indicated in equation (3.4.22). Z_s values can be higher than those specified in 1973 UBC but would account for a fault near the site or an important structure which are not explicitly mentioned in 1973 UBC.

C. Rating of Building Resistance to Wind Hazards

Information Necessary for the Method

This method should be used only when plans and specifications are available and it has been determined from the Data Collection Form, see Appendix A, that the plans represent the "as-built" structure. Original calculations, if available, will be of assistance in assessing the resisting capabilities of the various members. It is assumed that personnel familiar with the design of buildings to resist lateral forces will make these analytical evaluations.

Criteria for the Method

The standards used in analyzing the effects of wind or hurricanes on structures is ANSI A58.1-1972 [3.2] except as modified herein. Other loading functions may be used if deemed more appropriate for the site but criteria used should be stated (see section 3.4).

For the purpose of this evaluation, elastic analyses of building response will be compared with material design capacities. Design stresses will be those designated by latest nationally recognized material specifications. In the evaluation, buildings are being analyzed, but not designed. Stresses in structural elements will be checked for the combined effects of wind and vertical loads. Where wind loads are included, the combined stresses may exceed code working stresses by one-third, except where not permitted in the specifications, with the provision that the stresses resulting from design vertical loads alone will not exceed code design stresses.

Determination of Wind Forces on Building as a Whole

A Basic Wind Speed must be assigned to the area by the user. If no other basic wind speed is designated, the values will be taken from figures 3.22 to 3.26 and table 3.10. Unless the building to be evaluated is of unusual importance, the basic wind speed will be determined using a 50-year recurrence interval as shown in figure 3.25. The wind speeds to be used are for the annual extreme fastest mile speed 30 feet above the ground. The building involved will be given an exposure rating corresponding to Exposures A, B, and C of table 5 in 1972 ANSI which converts the basic wind speed to effective velocity pressures (q_F) at varying heights. From the q_F found in this manner, the horizontal force loading can be determined for each major axis of the building; these are for application to the external surfaces of the building.

Response Analysis of the Building as a Whole

In making a horizontal force loading diagram for a building as a whole, step functions may be made with height zones as described in section 6.3.4.1 of 1972 ANSI. This will simplify computational work on tall buildings.

The horizontal loading on windward walls and leeward walls is modified by coefficients C_p as expressed in the 1972 ANSI, table 7. For the building as a whole the effects are additive and for most buildings the applicable wind forces will be 1.4 to 1.3 times the effective velocity pressures (q_F) taken from table 5. This value is the design pressure for application to the building as a whole.

For tall buildings where height exceeds 5 times the least horizontal dimension or for buildings which may have unusually wind sensitive dynamic properties, a dynamic approach to calculating the building's response may be required. This is beyond the scope of this method. However, an example of this method is given in 1972 ANSI, Appendix A6.3.4.1. Figures A2 through A6 provide curves for simplifying the computations. Also, since the structures to be evaluated using the Approximate Analytical Method do not exceed 16 stories in height, it is improbable that many will exceed the 5 to 1 height-width ratio.

In determining the response of the building as a whole, the type of diaphragm system must be considered. A stiff diaphragm will distribute horizontal forces to vertical resisting elements in proportion to their relative rigidities. A flexible diaphragm will distribute forces to vertical elements more nearly proportioned to the tributary exposed wind surfaces. Detailed commentary of diaphragms is given in section 3.3B.

Assuming that the structural resisting system is known from field measurements and plans, and that the wind loading has been determined as described above, the calculations for the adequacy of the building to resist these forces can be made using any of the standard analytical procedures. The lateral loading to each level is determined with positive pressures on the windward side and negative pressures on the leeward side. The path by which these forces are transmitted to the vertical resisting elements is determined and the adequacy of such diaphragm or horizontal bracing system to transmit these forces is checked. A discussion of various types of diaphragms is given in section 3.3B. The vertical resisting elements, either shear walls, moment-resisting frames, or braced frames are then checked for these forces. Lateral forces are applied to these vertical resisting elements at each level and the stresses analyzed. The overturning stresses should be checked, including uplift on foundations. If the original computations are available they can be reviewed to see whether wind forces have been properly computed and distributed and whether the allowable stresses have been exceeded.

Computer programs are available which may be used for wind response on buildings, particularly for tall buildings with moment-resisting frames. If it is desired not to use such a computer check, there are several simplified hand calculation methods frequently used, such as the cantilever method, the portal method, the Spurr method [3.8]. These all make certain assumptions as to points of contraflexure and distribution of vertical load increments from overturning forces. The method that is most applicable to the facility being investigated should be used.

Determination of the Critical Elements

In analyzing a building for the assigned winds, some elements will have higher stress ratios than others. The building element having the highest stress ratio may be the most critical but may be of little importance to the building as a whole. For example, lateral resistance is provided by a large number of moment-resisting frames and one beam column connection is much more highly stressed than the rest. The higher stress of this element would cause redistribution of loads and stresses to other elements. Suppose there were fifty such connections at a particular level and that five of these, when analyzed, had 20% higher stresses than the others. If these five were stressed to yield, the stress redistribution to the other elements would involve only small increases. Therefore, these elements would not be considered the most critical and the critical stress ratio would be based on the lower stressed elements. Conversely, if the lateral forces are resisted by, say, only 4 to 6 vertical elements in a story, and one or two of these were found to have higher stresses than the others, these one or two elements would be considered important and should be listed along with their critical stress ratio. Where elements were found to be stressed beyond their design stress, a re-analysis of the probable path of redistribution of forces is recommended. This may involve the capability of the diaphragm to make such redistribution. If the forces can be redistributed without severe overstressing, the determination of the critical element will be easier to determine.

The usual critical elements for wind resistance are, as in earthquake resistance, the vertical resisting elements (shear walls, braced bays, or moment resistant frames) and the horizontal resisting elements (diaphragms). There is a major difference, however, in that wind forces are applied to exposed surfaces while earthquake forces originate at centers of mass and are proportional to mass. Thus a lightweight exterior wall might have a relatively small earthquake force normal to the wall but would be exposed to wind forces which are independent of the weight of the wall.

Determination of the Critical Stress Ratios

The highest ratio of stress resulting from the wind forces applicable to the site (f_w) to the allowable material design stress (f_a) (including 1/3 increase where permitted but deducting capacity required by gravity loads) on any critical element is termed the critical stress ratio f_w/f_a. The critical stress ratio is the indicator for evaluating the capability of the structure to resist wind forces. Load factors and ultimate capacities are used for concrete design and for plastic design of structural steel.

Analysis of Portions of Building

Both internal and external pressures must be considered on portions of buildings such as roofs and walls. Methods of calculating the internal pressures on roofs and walls are given in 1972 ANSI [3.2] (6.5.3.2.4 and 6.5.4). Corners of walls are exposed to high negative pressures. These corners should be checked as specified in 6.5.3.1 of 1972 ANSI.

Where structures are not enclosed, the roof is somewhat similar to a flat plate and tables 13 and 14 in 1972 ANSI (page 22) give coefficients for determining the net pressures to be used in design. If one end (or one side) or 25% of any exterior wall is open, the structure will be considered not enclosed.

The critical stress ratio is applicable to elements not part of the structural system of a building. For instance, the anchorage of wall cladding can ordinarily be computed. Given the horizontal force on such an element and knowing the distribution of anchors, the load to each anchor can be determined. For example, assume these anchors are bolts placed in tension by lateral forces on the element in question. The ratio of this computed tension to the allowable bolt tension is the stress ratio and is a measure of the adequacy of the anchorage.

Analysis of Anchorage of Exposed Elements

The wind forces (positive and negative) on exposed elements can be determined from 1972 ANSI as previously noted. If the anchorage of such elements is known, the adequacy of the anchorage devices can usually be computed by stress analysis. However, should the initial field examination reveal damage to exterior veneer, appendages or looseness of wall cladding panels which might be caused by corrosion or other chemical deterioration of anchorage, the anchorage should be reviewed in the field to determine whether such a condition is typical or is confined to one location. Also, after the Approximate Analytical Method evaluation has been made and the drawings examined, certain specific items or elements may be found critical and warrant an additional field inspection.

Commentary on Drift

In tall buildings, or other buildings with a high degree of flexibility, drift becomes important. Drift is usually expressed as a ratio of the lateral movement in a story to the story height. Excessive drift may cause damage to non structural elements such as partitions, wall cladding, and glass panels unless these elements are so isolated or cushioned that relative movements of adjacent stories will not exceed the isolation. Stiff, brittle elements such as partitions of unreinforced masonry or glass are more susceptible to this type of damage. Where such brittle elements occur on or near public ways, or from portions of exit enclosures, damage to these elements can be a hazard to human life. Reinforcement of brittle partitions can provide a basketing effect to reduce the hazard from falling pieces. Metal lath on wood or steel studs provides such a basketing effect. Glazing with resilient boundary materials provides a degree of isolation for glass panels. An old rule-of-thumb drift limitation is .0025. For the purpose of this method, wind drift can be ignored on obviously low, stiff buildings. However, the taller, more flexible buildings with moment-resisting frames should be checked for drift, and the effect of this drift considered in its effect on elements other than those of the structural system.

For example, assume that the computed story drift in a 12 ft story height is 0.3 in. Also, assume that an 8 in steel riser pipe is tightly embedded in the concrete floor construction at each level and is fixed at each floor.

Thus,

Pipe - Moment of inertia (I) = 72.5 in^4
- Section modulus (S) = 16.8 in^3
- Modulus of elasticity (E) = 29,600,000 psi
- Allowable stress (f_b) = 26,700 psi

Story height (h) = 144 in

Deflection (Δ) = 0.3 in

$$\text{Moment } (M) = \frac{Ph}{2}, \text{ where } P = \frac{12\ EI\Delta}{h^3}$$

$$\text{Stress in pipe} = \frac{M}{S} = \frac{6EI\Delta}{S\ell^2} = 11{,}300 \text{ psi}$$

This stress is well below the allowable stress and a drift of this magnitude will not break the pipe.

In this same story is a metal stud and plaster partition fastened to the top of the floor below and the bottom of the slab above. The net partition height is 12 ft - 6 in. Limited tests have indicated that such a partition may deform 1/16 in per foot of height with only minor cracking but without failure. Using this limited empirical limitation a drift of 0.75 in would be permissible. A procedure for checking the effect of drift on masonry walls or partitions is given in this section under Earthquake-Commentary on Masonry and Concrete Walls.

D. Rating of Building Resistance to Tornado Hazards

General Considerations

The purpose of this portion of this section is to establish a method for analytical evaluation of a building's resistance to the hazards imposed by tornadoes. Little has been published on design of buildings to resist the tornado hazard. Some excerpts of the available data are presented for assistance in implementing this method:

> "Tornadoes, the most violent of all storms, have long been viewed by many engineers as natural phenomena which should not be considered in design except for possible provision of emergency personnel shelters. However, since 1967, the Atomic Energy Commission (AEC) has required designers of nuclear reactor facilities to carefully consider the effects of tornadoes on such facilities. The AEC has included tornadoes as one of the natural phenomena which the nuclear power plant designer must consider in the design so such facilities can be constructed to successfully withstand the additional forces that might be imposed by a tornado without loss of capability to protect the public." [3.4]

The reader is referred to chapter 2 and also section 3.4 for further general comments concerning tornadoes. However, the following three points are worthy of further comment.

"Tornado Phenomena. The effects of a tornado that are manifested in structural damage are generated from two separate phenomena:

(1) wind, and
(2) changes in atmospheric pressure.

These tornadic effects interact with structures and cause damage through three principal mechanisms:

(1) pressure forces created by air flowing around the structure,
(2) pressure forces created by relatively rapid changes in atmospheric pressure, and
(3) impact forces created by missiles.

Pressure forces are applied to a structure when the flow of air (wind) is interrupted by the presence of the structure. The windward face of a structure will experience pressures acting inward, while the roof, side walls, and leeward face of the structure may experience wind induced pressures which act outward as shown in figure 3.12.

The atmospheric pressure change associated with the tornado is produced by the circular movement of air within the vortex. The minimum atmospheric pressure occurs at the center of the tornado. As a tornado approaches and passes over a structure the atmospheric pressure outside the structure reduced to a minimum value and then returns to ambient. The effects of tornado induced atmospheric pressure change on an unvented structure are illustrated in figure 3.13.

Missiles are generated by extreme winds associated with a tornado. They pose damage threats ranging in degree from breakage of a window glass caused by the impact of roof gravel to stability failure of a structural frame produced by the impact of an automobile." [3.3]

"Tornado - Structure Interaction -- When a structure is engulfed by a tornado field, wind velocities and atmospheric pressure changes do not act uniformly over the entire structure. Furthermore, these interdependent effects do not attain maximum values simultaneously at a point. These two observations have implications in the establishment of wind velocity and atmospheric pressure change criteria for use in structural design. The significance of the observations relates to the size of the structure relative to the diameter of the tornado. One of the methods of developing rational loading for the design of structures is to consider two extreme cases: (1) small structure - large tornado, and (2) large structure - small tornado. By consideration of these two extreme cases it would be possible to consider tornado diameter, structure size, structure orientation, and tornado translational velocity as variables. The results obtained using the two extreme cases would be utilized to develop guidelines for the design of tornado resistant structures." [3.3]

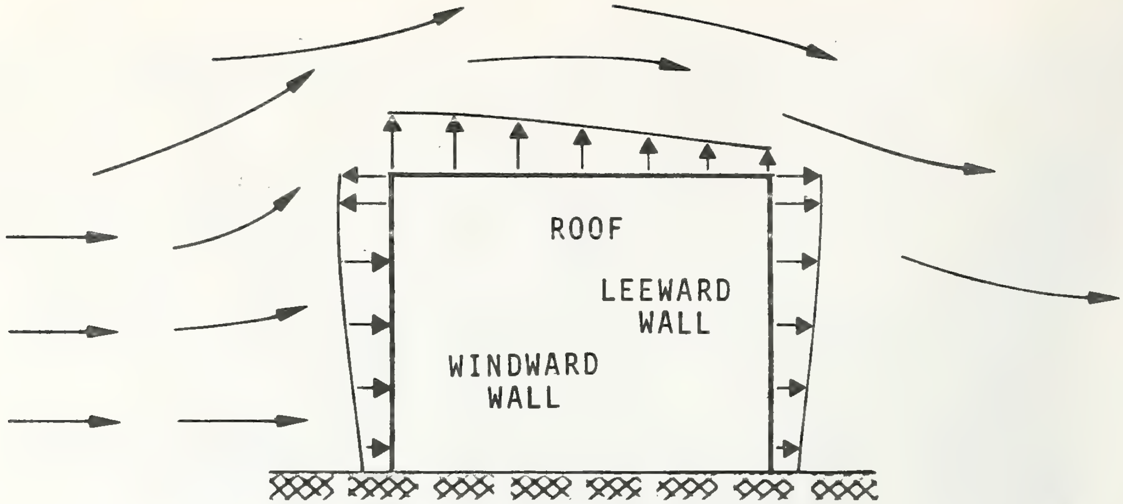


Figure 3.12 Typical Wind Induced Pressure Forces on a Structure

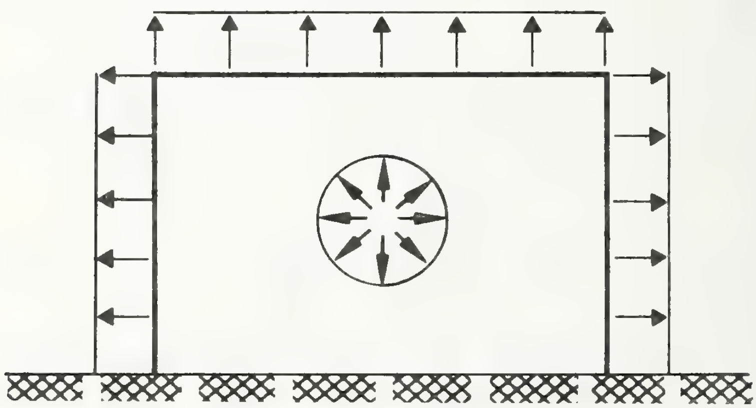


Figure 3.13 Typical Forces on an Unvented Structure Created by Rapid Atmospheric Pressure Change

"Degree of Protection Anticipated In structures where there is danger of releasing radioactive material to the atmosphere, for example in cases of a nuclear reactor containment vessel or a plutonium processing plant, degree of protection against tornado damage should be absolute. The absolute protection implies no structure damage and no damage to contents of the building from wind, water or missiles. However, in structures such as hospitals, fire stations, civil defense headquarters, etc., some structural damage can be tolerated as long as services are not interrupted. In such cases the degree of protection can be moderate. Researchers at Texas Tech developed design criteria for different degrees of protection for a warehouse. This particular warehouse was designed for tornado protection because unusually expensive material was to be stored in the warehouse." [3.3]

Information Necessary for the Method

It is assumed that plans of the building to be evaluated are available. It is also assumed that the probabilities and frequency of tornado phenomena in the area involved have been determined. Where the probability of occurrence is determined to be low, no tornado evaluation need be made.

Criteria for the Method

For the purpose of the Approximate Analytical Evaluation Method it will be assumed that only moderate protection is required for the building to be evaluated. Therefore a free field velocity of 200 miles per hour and a pressure drop of 1.2 psi will be used. These values are taken from table I in reference [3.3]. Using the formula $P = .0025V^2$ to convert velocity to pressure gives P = 100 psf. The 1.2 psi pressure drop is, converting units, equal to a suction or uplift of 172 psf.

From figures 3.12 and 3.13 it is obvious that the building as a whole is subjected to a total lateral force from both windward and leeward sides. If it is assumed that tornadoes are similar to other high winds, such as hurricanes, with respect to the relationship of pressures on windward and leeward sides, one finds these coefficients of the velocity pressures to be 0.8 and either 0.5 or 0.6, respectively; depending on the height-width ratio of the building. Thus the total lateral force on a building subjected to tornadoes for a moderate degree of protection will be 100 x (0.8 + 0.5 or 0.6) = 130 or 140 psf. These coefficients are taken from table 7 of 1972 ANSI and apply to enclosed structures.

There are probably very few buildings that will be undamaged if in the direct path of a strong tornado. The least likely to be severely damaged will be heavy reinforced concrete or reinforced masonry vault like structures one or two stories in height, with relatively heavy and solid walls. Taller buildings designed to resist hurricanes may have limited damage but probably will not collapse unless they are of unusual configuration or have large roof overhangs or open sides. Light buildings of wood frame or steel frame and metal sidings have been known to have been torn from their foundations and blown considerable distances. It is possible, however, to provide such light buildings with some resistance to winds by proper anchorage to foundations to resist uplift.

The structural systems of some buildings designed for earthquake may be capable of resisting forces created by tornadoes. For example, a warehouse 100 ft x 100 ft and 20 ft high with concrete roof and walls has been designed for an earthquake force of 0.133g. If the walls weigh 100 lbs per sq ft and the roof dead load is 100 psf, the total design horizontal force for an earthquake in either direction would be about 1,530 lbs per linear foot at the roof line as compared to 10 x 140 pounds or 1,400 pounds per linear foot for the moderate tornado design force.

Analysis of Building as a Whole

It should be obvious that many buildings will not warrant analytical evaluation. A short perusal of the plans of a building should determine whether a roof system has the weight, reverse load capacity, and anchorage to resist the extreme uplift forces associated with tornadoes, or whether an entire building is heavy enough to resist such forces. A quick look at the foundation details should show whether any special hold-down provisions have been used. Pile or caisson footings will have good potential uplift characteristics if anchored to foundations. For example, in a steel frame building, the presence of many large anchor bolts from base plate to concrete footing would indicate that uplift forces were probably considered in the design. Some concrete piles may have no reinforcing bars or only a single small reinforcing bar extending down from the pile cap into the pile a short distance. This would indicate that little or no consideration had been given to uplift forces. Deep basements will have good hold-down characteristics. In general, therefore, a light, one-story structure without special hold-down foundation characteristics can be given an inadequate rating without analytical calculations beyond a very rough assessment of weight as indicated in the Field Evaluation Method, section 3.2.

Light roofs of wood or steel are usually designed for a live load of not over 30 psf. For tornadoes, structures are to be checked for an uplift force of at least 172 psf. It will be found in most such cases that the net uplift is several times the design dead load. Such roofs can be considered inadequate to resist maximum tornado forces. This reasoning may not be true in areas where a heavy snow load is used in design.

If a building has been evaluated for wind and given a poor rating, it will be considered to be inadequate to resist tornadoes. The ability of roof systems, designed only for gravity loads, to resist reversals from uplift needs discussion. Steel beams with their compression flanges braced by the deck under usual gravity loads may have lower flanges unbraced and subject to compression buckling under uplift loads. Deep concrete beams, wood girders, and trusses need to be checked and analyzed for their capacity under such reversals. Even though these reversals may be only for a few seconds, the effect of such reversals must be considered and the roof anchorage details checked.

So far, these comments have been related primarily to uplift. The wall capacities must be checked for direct horizontal positive and negative force. The floor and roof systems must be checked for adequacy as diaphragms to transmit lateral forces to the vertical resisting elements. Once again the anchorage is of major importance. Anchorage of walls to footings should be checked for capacity to resist sliding combined with vertical uplift and overturning. The footings themselves should be checked for sliding resistance, uplift, and overturning forces. In checking these calculations, the purpose is to determine the ratio of stresses resulting from the imposed tornado loads to the capacity of the structure.

In each of the various resisting systems, such as roof, floors, shear walls, or moment-resisting frames, there may be one or more critical elements which will fail before the other elements. Care must be taken not to derate a building because of one non-important element. Where the failure of such an element would not cause failure of a system, but would only cause minor redistribution of loads, such a member would not be a critical element. Reference is made to further discussion of critical elements in this section.

Analysis of Portions of Building

It should be obvious that with positive and negative pressures of the magnitude encountered in tornadoes, such building items as exterior doors and windows, wall cladding, exterior appendages, and balconies will be very vulnerable and the average installation and anchorage of such items will not be adequate but will be checked to determine the critical stress ratio. Glass panes, unless designed especially for such pressures, as to size, thickness and strength must be checked for their adequacy for resisting tornado wind pressures.

3.4 DETAILED ANALYTICAL EVALUATION METHOD

A. Introduction

This section discusses the methodology and rationale involved in the development of a computer program that estimates the damageability of buildings under the following natural conditions:

- Earthquake
- Wind - General
- Tornado and Hurricane.

The methodology has intentionally been presented in a user oriented manner regarding the:

- Determination of environmental loads
- Definition of structural models and response computation
- Estimation of potential damage.

The method presented is essentially state-of-the-practice when balancing the uncertainties in the various fields against the value of detailed analysis at the most elementary level. Reference [1.4] presents a collection of various state-of-the-practice papers.

The section presents the methodology behind a modular computer program which brings together the many aspects of the damageability prediction problem. The computer program may be readily updated to incorporate new developments in any selected module.

The reader must realize that by the very nature of structural engineering and more specifically, the architect-structural engineer relationship, that one computer program cannot hope to structurally model all possible building types and still be economical to use. Therefore, a procedure is presented which is appropriate for a reasonably large class of building structures. In particular, the program can be used to estimate the damageability to the following structural types:

- Braced and unbraced steel frame buildings
- Concrete shear wall and shear wall plus frame buildings
- Bearing wall buildings
- Long span roof structures.

All buildings are assumed to act in a two-dimensional or inplane manner and hence, buildings with significantly irregular floor plans (e.g., T or L shaped) or structural framing, cannot, with a high degree of confidence, have their damageability assessed with this program. Also, damage in buildings for which soil-structure interaction is important cannot be estimated with high confidence. Only an experienced structural and/or soils engineer can establish whether the building under consideration is in one of the two latter categories.

The developed computer program utilizes the professional experience of the engineer. The engineer must provide judgmental input as to the (1) quality of building construction, (2) deformation for the structural components to yield and failure, (3) completeness of the site description properties, and more. Therefore, the computer program enables the engineer to quantify his professional experience about many component aspects of the problem without having to specify how they all interrelate in establishing building damageability.

A direct comparison of this method with the two previously discussed evaluation methods is not simple. The Detailed Analytical Evaluation offers the engineer a computer program with many options. It is possible to obtain damage estimates for a building using this program in a matter of minutes or it can take days depending upon the complexity of the structural model. Also, much of the required input for the procedure can be obtained using the judgmental values of engineers documented in this section or the establishment of these input values may require days of study so as to obtain the best estimated values for the building under study. Philosophically the Approximate Analytical and Detailed Analytical Evaluation Methods differ in two respects. One, the Approximate Analytical Method is based upon a stress damage evaluation. The stress in critical elements is calculated and compared with code stress levels. The methodology discussed in this section relates structural and most nonstructural damage to interstory drift. Local member stresses are not calculated. Earthquake nonstructural damage is related to an effective floor MMI through an estimate of floor response. The second major difference is the sophistication of the analytical building model. A finite element type model is used in the latter method whereas a more simple model is usually used in the former method.

B. Natural Hazard Loading - Earthquake

General Comments

The method used for generating earthquake loads on buildings entails four basic steps:

1. Determination of seismicity, A, as a function of geographic location. The Richter magnitude, M, of a representative earthquake is derived from the seismicity of a particular site.

2. Determination of an effective hypocentral distance, r, which locates the representative earthquake with respect to the building site. Computation of r involves the attenuation properties of the Earth's crust in the vicinity of the site.

3. Specification of a hard-rock particle velocity spectrum, $V_{HR}(T)$, for the site. This too will involve the attenuation properties of the Earth's crust.

4. Generation of a soil amplification factor, $(DAF)_s$, for the site which, when multiplied by the hard-rock velocity spectrum results in a ground site particle velocity spectrum, $V_{site}(T)$.

The ground site spectrum characterizes the dynamic environment of the building and will be referred to as the "earthquake load." A flow diagram depicting this sequence of operations is shown in figure 3.14.

The procedure used to develop the ground site spectrum parallels that presented by Algermissen [1.4]. It does not, however, explicitly consider proximity of the site to known faults. Efforts are underway by the U.S. Geological Survey to develop earthquake risk maps incorporating this factor.

Recognizing that a professional consensus does not exist relative to the most appropriate procedure for obtaining a ground site spectrum, an option was included in the computer program for the Detailed Analytical Evaluation Method to permit the user to bypass the computation of earthquake loads described in this section and input directly a ground particle velocity spectra (see Section 2.1.1.3 Appendix E).

The earthquake load generation approach is empirically based wherein certain relationships are derived by dimensional analysis and curve fitting of observed earthquake data. The seismicity at a site is a parameter which represents the amount of seismic activity (number of earthquake events per year) within a specified radius of the site. This area defined by this radius is referred to as the "felt area" about a given site. The radius which defines the area is a function of the attenuation properties of the earth's crust within that region. The seismicity at a site is defined in accordance with all available historical earthquake data [3.12], [3.13]. Typically, these references provide the date of earthquake occurrence, its location, and its magnitude or intensity.

Other recorded data provides the maximum ground acceleration, velocity and displacement experienced at a sight for earthquakes occurring within the felt area. These data are not available for all parts of the country, but coupled with known geological characteristics, can be extrapolated and used as the basis for establishing attenuation characteristics for the earth's crust. Since measureable ground motion characteristics include the effects of local soil conditions, prior to developing attenuation characteristics a soil model must be generated to relate the site ground motion to the motion of basement rock which underlies the site.

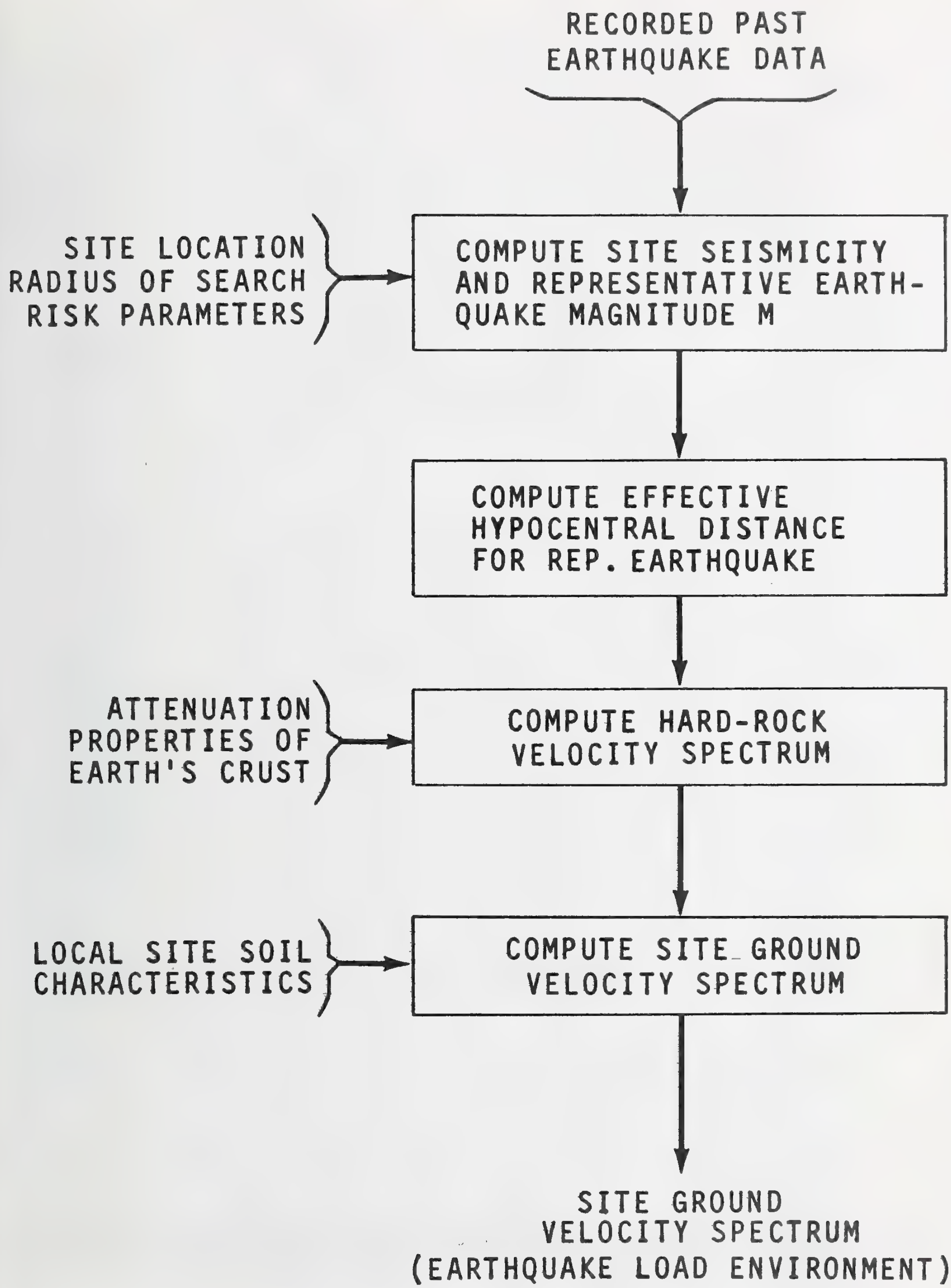


Figure 3.14 Generation of Earthquake Load Environments

The remaining paragraphs of section 3.4B are organized according to the following four steps. First, historical data is used to determine seismicity A as a function of geographical location. An equation is presented which relates earthquake magnitude to frequency of occurrence with A as a parameter. In order to determine the dynamic environment of a building due to earthquake of magnitude M, the earthquake hypocenter must be located relative to the site. Therefore, the section contains a description of the method used to determine an effective hypocentral distance r. Next, a description is presented of how a hard-rock velocity spectrum is obtained for a site using available records of maximum acceleration, velocity and displacement corresponding to particular earthquakes of known magnitude and distance from the recording site. Finally, various techniques available are presented for generating soil models and corresponding amplification factors for computing earthquake loads from hard-rock spectra.

United States Seismicity

Earthquake loads derived herein for a particular site are based on past earthquake data. Some areas of the country have exhibited a great amount of seismic activity while others have exhibited little or none. Thus, the distribution of seismicity throughout the country is of fundamental importance. A tabular format has been chosen for the presentation of seismicity characteristics throughout the country. The continental U.S., Alaska and Hawaii have each been subdivided into one-half by one-half degree grid areas (4360 for the Continental U.S., 2516 for Alaska and 92 for Hawaii)as shown in figures 3.15 to 3.17. For each grid area this section discusses how one calculates a mean seismicity, $\overline{A}$, and a seismicity standard deviation, σ_A, based on a statistical analysis of all available earthquake data. Values of $\overline{A}$ and σ_A are given in Appendix H for each grid area. These values are based on a statistical analyses of all available earthquake data.

This treatment of the past earthquake data is based on an approach proposed by Wiggins and Moran [1.1], and involves the seismicity relationship

$$\log_{10} N = A - bM \tag{3.4.1}$$

where

A ≡ seismicity at a given site

M ≡ Richter magnitude

N ≡ frequency of occurrence (events per year) of earthquakes of magnitude M or greater

b ≡ a distribution characteristic governing the relative frequency of earthquakes of different magnitude

(1/N) ≡ earthquake return period

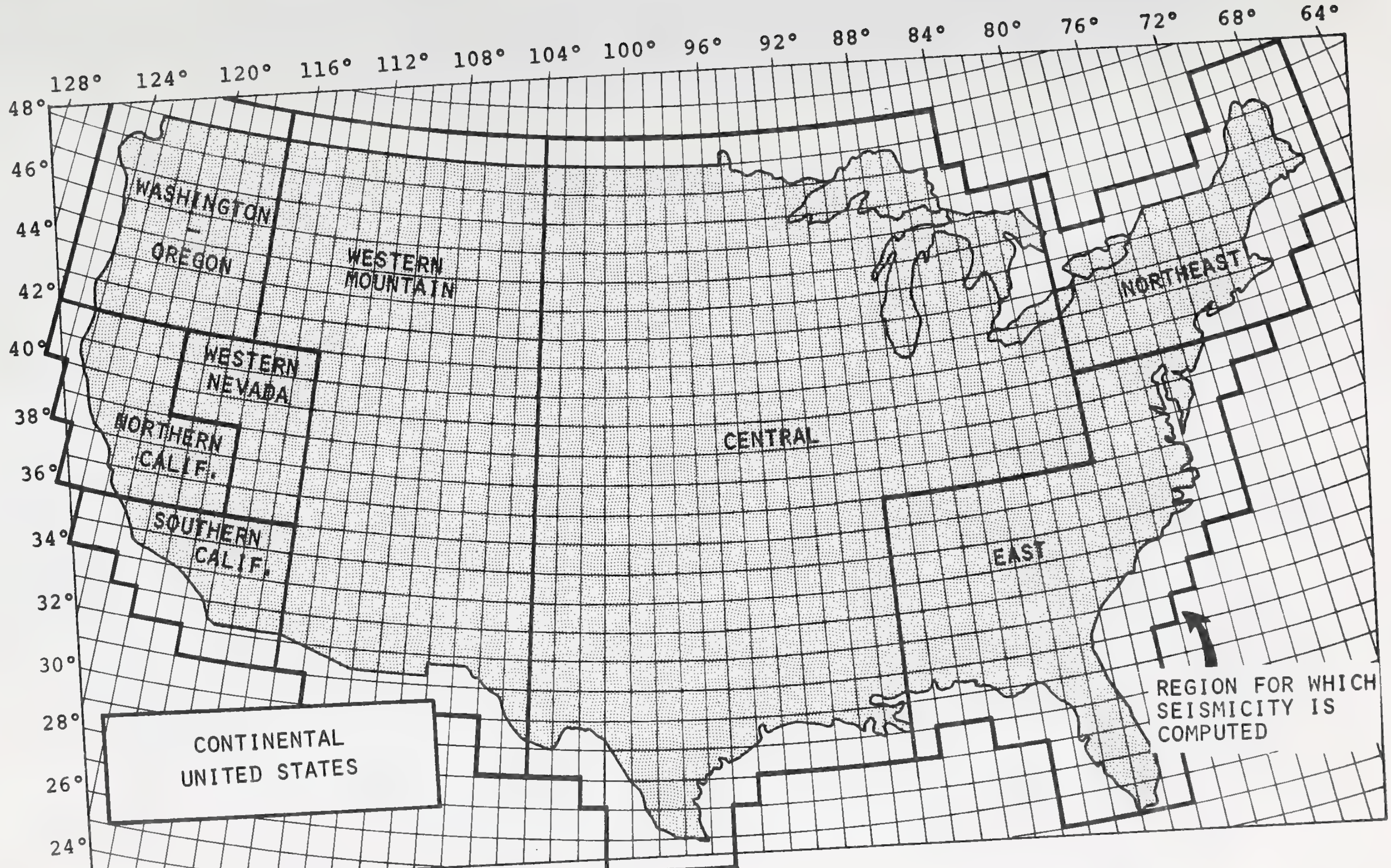


Figure 3.15 Seismicity Grids for the Continental U.S.

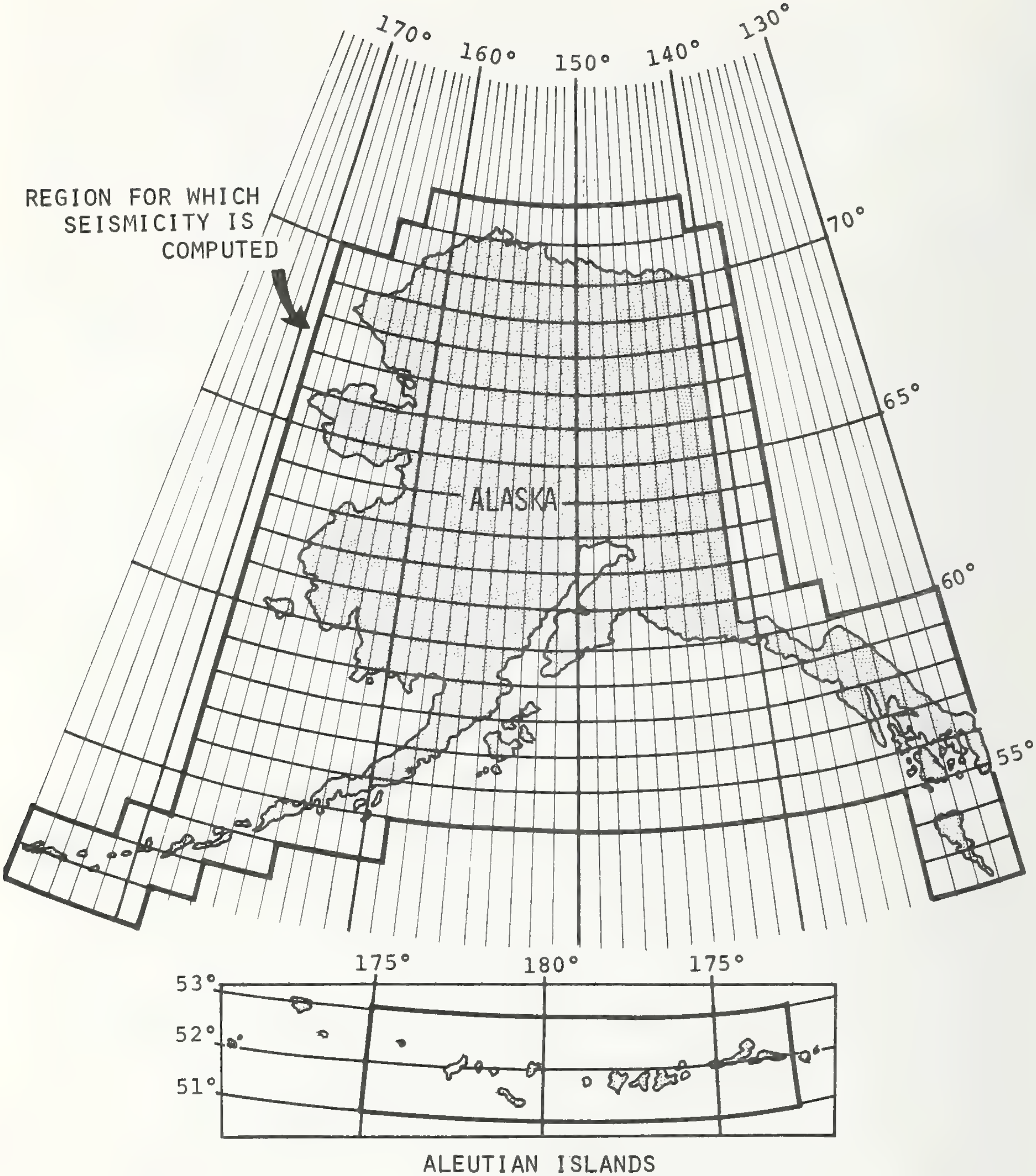


Figure 3.16 Seismicity Grid for Alaska

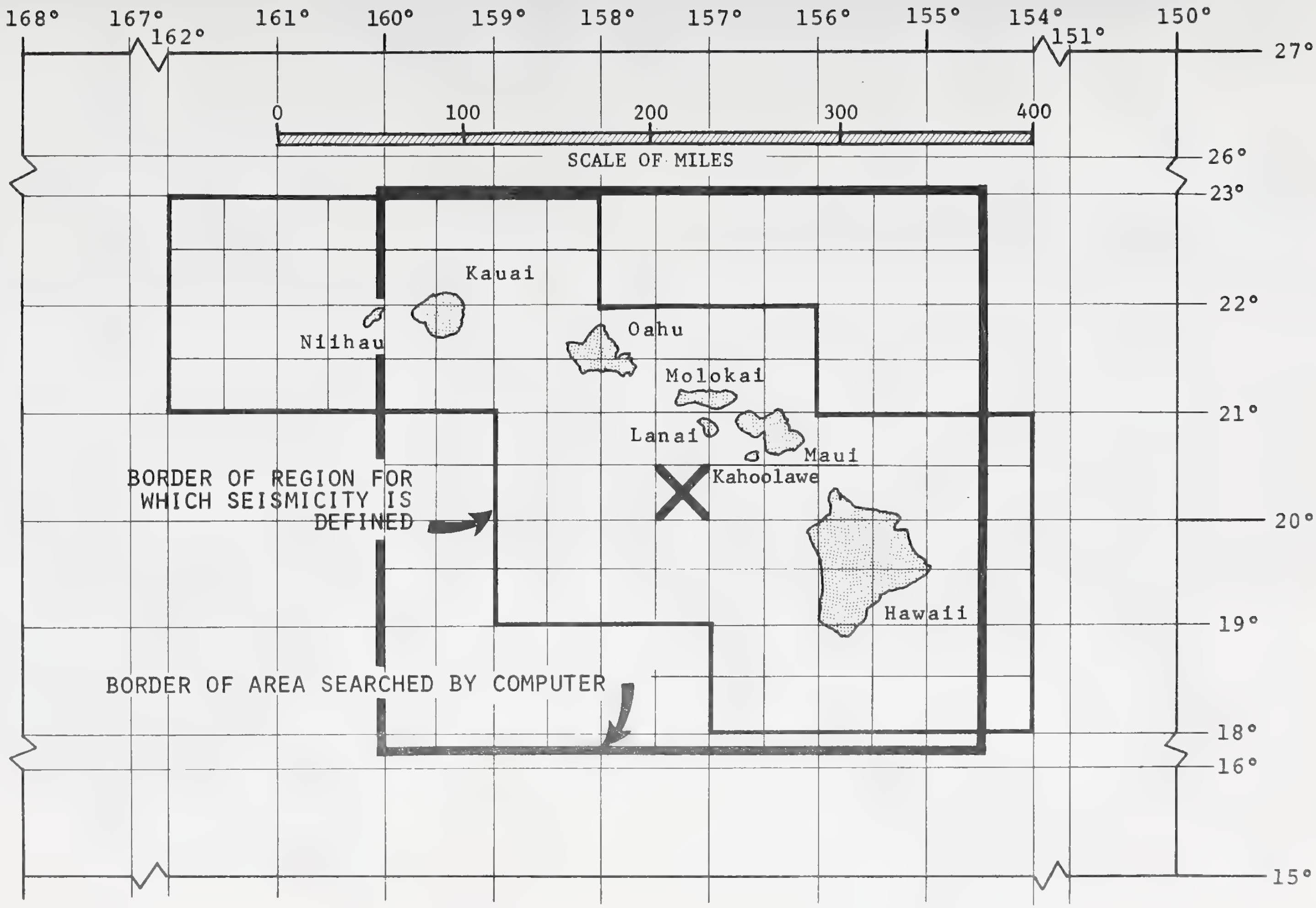


Figure 3.17 Radius of Search for Finding Seismicity (A) of Typical Grid

The value of b = 0.9 appears to be a constant independent of location as evidenced by the following:

(1) World Seismicity [1.1] reveals b = 0.88.

(2) Recent work by Nuttli [3.14] reveals that b = 0.927.

(3) Bollinger [3.15] derived a value for b = 0.87 $\pm$ .12 for all shocks in the Eastern United States.

(4) Chinnery [3.16] and Gordon [3.17] obtained similar results as above.

Equation (3.4.1) allows one to compute the seismicity A at a particular site in the United States in the following manner:

Step 1: Input of Earthquake Data Sources

The earthquake data bank consisted of two types of information:

a) Recent (NOAA) Data - these are earthquake data recorded since 1961 (see [3.13]) which give complete information about each earthquake including its location and Richter magnitude. These data are assumed to be a complete record of seismic activity of Richter magnitude 3.5 or greater over the 12 year period, 1961-1973.

b) Historical Data - these are earthquake data taken prior to 1961 (see [3.12]) and include data recorded as long as 323 years ago in the Northeast region of the United States. Information about each earthquake includes date, location, Modified Mercalli Intensity (MMI)and felt area (area throughout which earthquake was felt). Because of the non-scientific measurements used for this type of data (Modified Mercalli Intensity) and knowledge that smaller earthquakes may have not been recorded due to sparsity of population in some areas, the historical data were modified in the following two ways:

- Intensity Modifications for Adjustment to Epicenter - From data published by Wiggins [3.18], attenuation equations (found from regression techniques) have been developed to relate the Modified Mercalli Intensity at a site, to magnitude and hypocentral distance in the western region of the United States, namely California (Ferndale and El Centro) where 16 significant earthquakes were recorded on strong motion accelerographs at each site. The resulting equation for the western region (longitude $\geq$ 105°) of the United States is:

$$MMI = 2.786 + 1.5M - 3.742 \log_{10} r \qquad (3.4.2)$$

where

r = hypocentral distance (miles)

MMI = Modified Mercalli Intensity at site of interest

M = Richter magnitude at epicenter

The value for the coefficient to M was forced to be 1.5 in equation (3.4.2) since Gutenberg and Richter [3.19] give the relationship that $M = 1 + 2/3\ MMI_o$ (MMI_o = maximum Modified Mercalli Intensity at the epicenter).

Using relationships presented by Algermissen in [1.4, page 119], a similar attenuation equation can be developed for the eastern region of the United States. The value of the coefficient of M in the equation was again forced to be 1.5, since various tests of the data and theoretical examinations for energy revealed that this simple relationship held for all parts of the country (for shallow earthquakes) as well as for California. The resulting equation for the eastern region is:

$$MMI = 1.622 + 1.5M - 2.61 \log_{10} r \qquad (3.4.3)$$

Equations (3.4.2) and (3.4.3) can be used to express MMI_o in terms of the felt area by substituting an isoseismal value of 4 for MMI (lowest intensity felt), replacing M with $(1 + 2/3\ MMI_o)$ and noting that Area $\simeq \pi r^2$. The two resulting equations are:

<u>Western Region (longitude ≥ 105°)</u>

$$MMI_o = -.286 + 1.871 \log_{10} \left[\frac{(\text{Area felt})}{\pi}\right] \qquad (3.4.4)$$

<u>Eastern Region (longitude < 105°)</u>

$$MMI_o = .878 + 1.31 \log_{10} \left[\frac{(\text{Area felt})}{\pi}\right] \qquad (3.4.5)$$

Therefore, for historic data [3.12] where the subjective Modified Mercalli Intensity is used, a comparison is made for each earthquake between the intensity recorded and the intensity given considering the area felt via equations (3.4.4) and (3.4.5). The larger of the two values is kept.

- Intensity Modifications for Low Population Density - The historic earthquake data were further modified by multiplying the number of MMI_o values reported or computed from felt area reports (whichever was the larger) by the factors in table 3.5. These factors were based on population density statistics given in various World Almanacs and Statistical Abstracts of the United States. It was assumed that $MMI_o = 9$ and above would be noticed since the beginning of recorded time. The number of events less than $MMI_o = 9$ was increased by relating the ratio of population densities over time before 1930 to the felt area.

Table 3.5 ESTIMATED HISTORIC EARTHQUAKE MULTIPLICATION FACTORS

Region	Year of First Observation	Number of Years to 1961	Multiplication Factors for MMI							
			XII	XI	X	IX	VIII	VII	VI	V
Northeastern	1638	323	1	1	1	1	2	2	3	3
Eastern	1663	298	1	1	1	1	2.3	2.3	4	4
Central	1699	262	1	1	1	1	2.3	2.3	4	4
Western Mountain	1852	108	1	1	1	1	2	2	5	5
Washington-Oregon	1841	120	1	1	1	1	2.3	2.3	4	4
Alaska	1786	175	1	1	1	1	3.2	3.2	7	7
Hawaii	1834	127	1	1	1	1	2	2	4	4
So. California	1769	192	1	1	1	1	2.5	2.5	5.3	5.3
No. California	1808	153	1	1	1	1	2.5	2.5	5.3	5.3
Western Nevada	1860	102	1	1	1	1	2.5	2.5	5.3	5.3

After obtaining the modified MMI_o intensity values for the historical data, the final conversion from MMI to M was made using the equation $M = 1 + 2/3\ MMI_o$.

Step 2: Creating N versus M Cumulative Histograms

With the earthquake data properly modified and divided into two sets (recent and historical), each earthquake may be placed into the appropriate grid area based on its latitude and longitude (and then into one or more storage bins within that grid as shown in table 3.6). The parameter N denotes the number of earthquakes above a certain magnitude divided by the time period spanned by the data. For example, if one is considering data showing the occurrence of ten earthquakes of magnitude greater than or equal to Richter Magnitude 5.5 within a period of ten years, one would place ten earthquakes in bin number 5 and divide by ten to obtain N = 1. If one does this for each bin and then forms a Histogram, the results might appear as shown in figure 3.18.

Table 3.6 STORAGE BINS FOR TYPICAL GRID AREA

Bin Number	Earthquake Magnitude M Greater than:
1	3.5
2	4.0
3	4.5
4	5.0
5	5.5
6	6.0
7	6.5
8	7.0
9	7.5
10	8.0

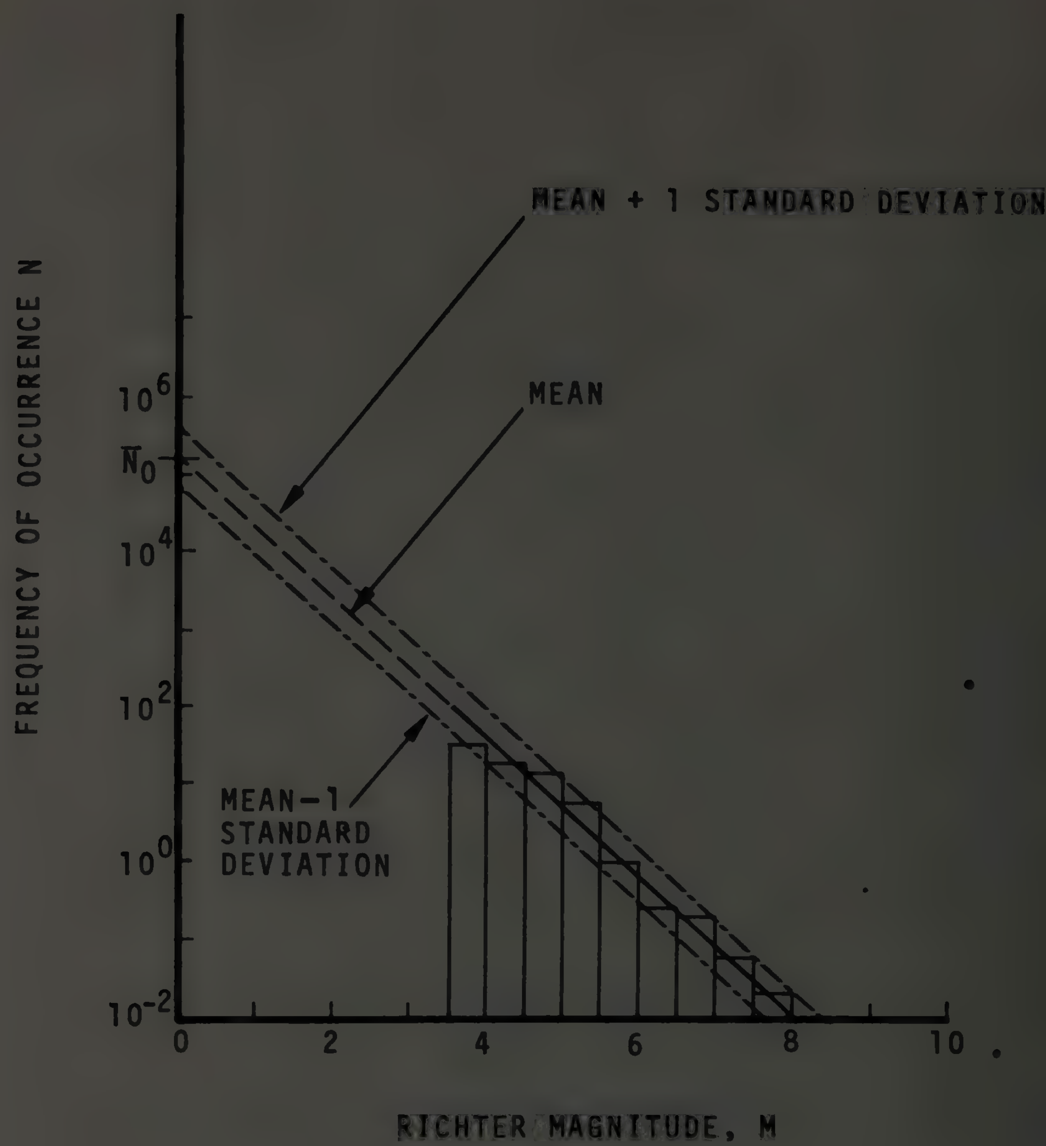


Figure 3.18 Cumulative Frequency of Occurrence Histogram

A regression fit to the cumulative frequency of occurrence data using equation (3.4.1), with the slope b set at b = 0.9, will produce a mean value, $\overline{N}_o$, for the intercept of the regression line and the vertical axis. The mean seismicity, for the grid, $\overline{A}$, is now defined to be

$$\overline{A} \equiv \log_{10} \overline{N}_o \tag{3.4.6}$$

The corresponding standard deviation of the grid seismicity is denoted σ_A. The value of σ_A is obtained directly from the previously discussed regression fit. Although the grid seismicity, A, has been treated as a random variable in determining $\overline{A}$ and σ_A, it will be convenient to henceforth consider A to be deterministic in the sense that

$$A = \overline{A} + n\sigma_A \tag{3.4.7}$$

To amplify this point, A, as defined in (3.4.7), is hereafter referred to as the grid's <u>Engineering Seismicity</u>. The parameter n may be set equal to zero in which case one's confidence, based upon a normal probability density function, would be 50 percent that the seismicity for that grid (i.e., site) does not exceed A. If n = 2 the corresponding confidence level would be 95 percent.

Step 3: Define Radius of Search

In calculating the seismicity A, it is appropriate to determine which earthquake events in the vicinity of the site are able to cause damage. This is done as follows:

a) Define the maximum probable earthquake for the site, M_{max}, as having a return period (1/N) equal to 400 years. This value may be compared to Gordon's estimate of 450 years for New England [3.17] and Nason's estimate of 220 years or longer for a specific location on the San Andreas fault [1.4]. Then from equation (3.4.1), assuming that the seismicity of the site does not change with time, one may write

$$\log_{10} N_H + bM_H = \log_{10} (1/400) + bM_{max} \tag{3.4.8.a}$$

If M_H is the magnitude of the largest earthquake recorded during historic time $T_H = 1/N_H$, then one finds that

$$M_{max} = M_H + \frac{1}{b} \log_{10} (400/T_H) \tag{3.4.8.b}$$

b) By using M_{max} from equation (3.4.8), the attenuation equations (3.4.2) and (3.4.3) which relate magnitude to hypocentral distance for the western and eastern regions of the United States, and by specifying that a value of intensity below MMI = 6.7 will cause no damage (see [3.11], Appendix H), a radius is found beyond which the maximum probable earthquake for a region will cause no damage even if it occurs. This gives

Longitude ≥ 105°

$$\log_{10} r_s = \frac{2.786 + 1.5M_{max} - MMI}{3.742} \qquad (3.4.9.a)$$

For regions: Washington, Oregon, Northern California, Western Nevada, Southern California, Alaska and Hawaii.

Longitude < 105°

$$\log_{10} r_s = \frac{1.622 + 1.5M_{max} - MMI}{2.61} \qquad (3.4.9.b)$$

For regions: Central, North and East

where

r_s = radius of search beyond which the maximum probable earthquake specified for each region will cause no damage.

Table 3.7 gives the radius of search for each of the regions listed above. It is noted that on the computer, the search was made more efficiently and economically by converting the search area to a square having the same area as the circle of influence. Thus, $\log_{10}(4/\pi)$ was subtracted from the above equations to obtain the radius of search for each of the regions listed in table 3.7. It is noted that earthquake data were stored in the grids beyond the dark line boundaries shown in figures 3.15 to 3.17 to accommodate searches extending past these boundaries.

Numerical Example for Computing A

Having divided the past seismic data into two separate sets (historic and NOAA), creating the N versus M histograms for each grid shown in figures 3.15 - 3.17, and defining a radius of search for each region, the seismicity (assumed constant in each 1/2° by 1/2° grid) can be calculated for all grids using the historical and NOAA data separately.

Table 3.7 DISTANCE OF SEARCH FOR AN EQUIVALENT SQUARE FOR VARIOUS REGIONS OF THE UNITED STATES

Region	MMI_o(max) Historic (MMI)	Years of Data	M_H^{**} (400 yr)	Distance Search for a Square (mi)
North Eastern	9	335	7.1	105
Eastern	10	310	7.8	264
Central	10	274	7.8	264
Western Mountain	10	120	8.3	158
Washington/ Oregon	9	132	7.5	76
Northern California	10.8	165	8.5 (8.63)*	191
Southern California	11	204	8.5 (8.65)*	191
Western Nevada	11	114	8.5 (8.94)*	191
Alaska	11.1	187	8.5 (8.77)*	191
Hawaii	10	139	8.2	145

*Computed values. 8.5 is assumed upper bound magnitude for the U.S.

**$M_H = 1 + 2/3\ MMI_o(\max)$

A sample grid area in Hawaii (marked by an X in figure 3.17) is used to illustrate the procedure for computing A.

From table 3.7, the radius of search for Hawaii is found to be 145 miles. Therefore, a square is created around the grid marked X that is approximately 290 miles across (approximate because if the radius of search falls in the middle of a grid it is extended out to the end of it). This square is indicated by bold lines in figure 3.7.

For each set of data (historic or NOAA) used, the N's for each M are summed over all grids falling within the area of search. (In this example there are 121 grids over which to sum). This allows N versus M histograms to be created for the entire area of search, similar to that shown in figure 3.18. Then a line with -0.9 slope is drawn through a point at the top center of each rectangle in the histogram. Each line so drawn defines an intercept A_i and this intercept corresponds to a seismicity value appropriate for a certain magnitude of past earthquakes, i.e., that magnitude which corresponds to that rectangular grid in the histogram. The average seismicity for the grid is then found by averaging the A_i's, i.e.,

$$\bar{A} = \frac{1}{n} \sum_i A_i \qquad (3.4.10)$$

where the index i (corresponding to the Bin No. in table 3.6) ranges over all of the bins.

The standard deviation of grid's seismicity is found from the equation

$$\sigma_A = \sqrt{\frac{1}{n} \sum_i (A_i - \bar{A})^2} \qquad (3.4.11)$$

Having obtained $\bar{A}$ and σ_A, an <u>Engineering Seismicity</u>, $A = \bar{A} + n\sigma_A$, may be established after specifying a value for n.

A complete summary of the United States Seismicity is contained in Appendix H.

Definition of Earthquake Risk Parameters

Having computed $\bar{A}$ and σ_A for all of the grid areas shown in figures 3.15 to 3.17, one is in a position to establish representative earthquakes, for use in computing earthquake loads for buildings, for any part of the country based on historical data. There are two ways to do this. The first is to specify a return period, 1/N, for the representative earthquake. In this case, the earthquake represents the maximum earthquake likely to occur during a return period T = 1/N. Its magnitude is given by

$$M = \frac{1}{b} (A - \log_{10} N) \qquad (3.4.12)$$

where

$$A = \bar{A} + n\sigma_A$$

and n is specified by the engineer according to a desired level of confidence. The set value of n establishing the percent confidence that M will not be exceeded during the time T.

An alternate way to compute M is to recognize that the random occurrence of earthquakes of magnitude M or greater can be described by a Poisson process where the probability of non-occurrence, p, is given by

$$p = e^{-LN} \qquad (3.4.13)$$

and L denotes the lifetime of the building. Thus, a representative earthquake of magnitude M may be established such that the probability of M not being exceeded in a period of L years is p. For example, if the life of the building is 20 years (i.e., L = 20) and an acceptable probability of non-occurrence is 0.90 (i.e., p = 0.90) then the corresponding return period, T, is obtained from (3.4.13) is

$T = (1/N) = -L/\ln (p) = 20/0.1045 = 191$ years and

$N = 0.00522$

If the engineering seismicity, A, is equal to 5.0 then the computed Richter magnitude is

$$M = \frac{1.0}{0.9} (5.0 - \log_{10} .00522) = 8.10$$

Effective Hypocentral Distance

In order to estimate the ground motion at the basement rock underlying a site, both the magnitude and distance of a representative earthquake are required. This section explains how the latter is obtained using past earthquake data. The distance from a particular site to the source of a seismic disturbance is called the hypocentral distance and is denoted by r. Since the source of an earthquake is usually some distance below the surface of the earth's crust, the hypocentral distance is defined as the hypotenuse of the right triangle shown in figure 3.19, assuming a flat earth for the relatively small distances involved. It is furthermore assumed that the focal depth of all earthquakes is 10 miles below the surface.

In contemplating ways to compute an effective hypocentral distance from a site to some representative earthquake whose magnitude is determined from equation (3.4.12), the need for some means of averaging the hypocentral distances to individual earthquakes contained in the data base becomes apparent. Further consideration reveals that a simple arithmetic average is inappropriate because the seismicity of the site (and therefore the magnitude of a representative earthquake) is dominated by the stronger earthquakes recorded around the site. Simple averaging does not take into account the relative magnitudes of the earthquakes which have occurred, only their respective locations. Thus, for example, if the data base contained only two events over a time period L, a magnitude 8 earthquake directly under the site, (r = 10 miles) and a magnitude 6 earthquake 100 miles away (r = 100), the representative earthquake for the same period of time would have a magnitude of at most 8, and an effective hypocentral distance equal to 55 miles. Clearly, the ground motion resulting in this case will be considerably lower than that resulting from the magnitude 8 earthquake with its epicenter at the site, and therefore will underestimate the dynamic environment of the site.

An averaging method which uses magnitude in some form of weighting scheme would seem to be desirable. A second alternative considered involved the use of an energy equivalence involving particle velocities at basement rock due to the various earthquake events occurring in the vicinity of the site. This led to the equation

$$V^2 = \sum_i V_i^2 \qquad (3.4.14)$$

where V_i represents the particle velocity at basement rock due to the ith earthquake event some distance r_i away, and V represents the particle velocity of the representative earthquake at a distance r away. In order to use this equation, we must be able to determine V (or V_i) given M (or M_i) and r (or r_i). The velocity attenuation equation

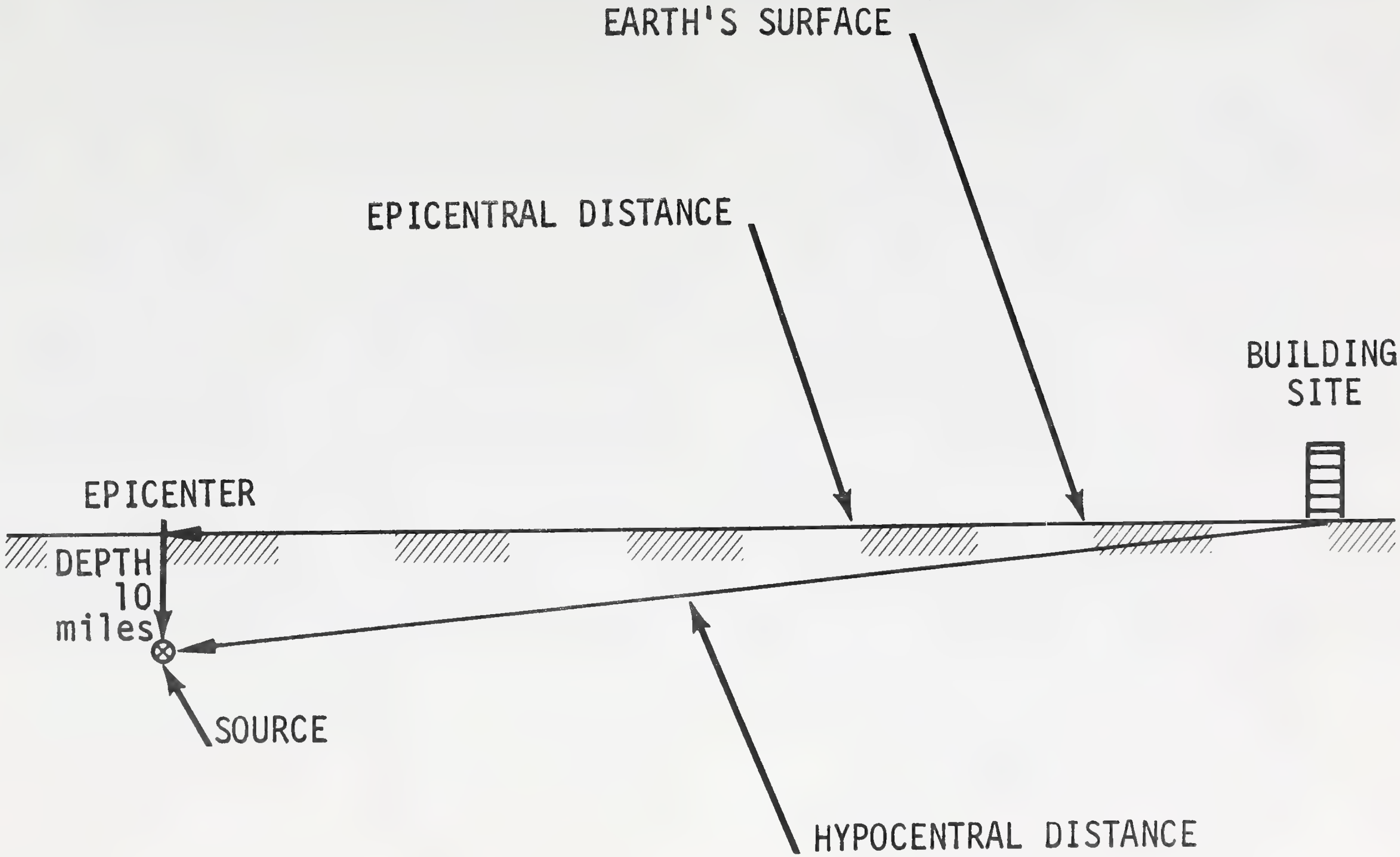


Figure 3.19 Illustration of Hypocentral Distance

$$V = C_1 \; 10^{C_2 M} \; r^{-C_3} \qquad (3.4.15)$$

discussed in later paragraphs of this section is applicable here, the subscript on r and V being omitted for notational convenience. Thus, the attenuation relationship involving V_i, may be written

$$V_i = C_1 \; 10^{C_2 M_i} \; r_i^{-C_3} \qquad (3.4.16)$$

Substitution of V and V_i from equation (3.4.15) and equation (3.4.16) into equation (3.4.14) enables one to solve for r in terms of M, M_i and r_i.

Although this approach has some appeal and tends to give reasonable values for r, the stipulation of an energy equivalence is somewhat arbitrary and in fact, turns out to be inconsistent with the basic seismicity equation (3.4.1). In Appendix J of [3.11] the derivation of an alternate equation which is used in place of equation (3.4.14) is derived and is

$$V^{b/C_2} = \sum_i V_i^{b/C_2} \qquad (3.4.17)$$

It is seen to be similar in form to equation (3.4.14), but replaces the exponent 2 with the constant $b/C_2 = 1.60$ where $b = 0.9$ and $C_2 = 0.563$ as given in later paragraphs of this section.

Equation (3.4.14) suggests a possible interpretation for equation (3.4.17). Instead of interpreting equation (3.4.14) as an energy equivalence, we may take the point of view that V is given as well as each of the V_i's, and furthermore that all of the V_i's are equal. Then the upper limit n of the index i becomes the unknown variable in the equation

$$V^2 = \sum_{i=1}^{n} V_i^2 = n \; V_i^2 \qquad (3.4.18)$$

Thus the equivalence factor is n which specifies how many earthquakes causing a site (basement rock) velocity V_i are equivalent to one earthquake causing the velocity V. In the case of equation (3.4.14), for example, if the ratio $V/V_i = 10$, then $n = 100$. In the case of equation (3.4.17) one sees that for the ratio $V/V_i = 10$, $n = 10^{1.6} = 40$.

Therefore, forty earthquakes producing a hard-rock velocity of $V_i = 1$ are equivalent (from the standpoint of seismicity) to one earthquake producing a hard-rock velocity of $V = 10$.

This relationship is even more apparent from the relationship (also derived in Appendix J of [3.11]).

$$\log_{10}N = \left[A + \frac{b}{C_2}\ \log_{10}C_1 - C_3\left(\log_{10}r\right)\right] - \frac{b}{C_2}\ \log_{10}V \qquad (3.4.19)$$

which comes about from substituting equation (3.4.15) into equation (3.4.1) to eliminate M. This equation when compared with equation (3.4.1) reveals the same linear form, treating the quantity in square brackets as a constant with a negative slope of b/C_2 instead of b which appears in equation (3.4.1). Thus it is evident that the quantity b/C_2 is just the slope of the $\log_{10}$ N versus $\log_{10}$ V histogram which could be developed directly from the data using equation (3.4.16).

Finally then, substituting for V and V_i from equation (3.4.15) and equation (3.4.16) into equation (3.4.19) gives the result

$$r = \left[\sum_i 10^{(M_i - M)}\ r_i^{\ -bC_3/C_2}\right]^{-C_2/bC_3} \qquad (3.4.20)$$

Equivalently, using equation (3.4.1) one concludes that

$$r = \left[\sum_i 10^{(A_i - A)}\ r_i^{\ -bC_3/C_2}\right]^{-C_2/bC_3} \qquad (3.14.21)$$

In actually computing r, an approximation was made to reduce computing time. Instead of treating each recorded earthquake individually where the index i ranges over the number of earthquakes within the radius of search, representative earthquakes of magnitude M_i were computed for each 1/2 x 1/2 degree grid area and located at the center of that area. The r_i's then represented the distance between the site and the center of each of these grid areas.

Generation of a Hard-Rock Velocity Spectrum

This section describes how a hard-rock velocity spectrum is developed from the Richter magnitude and hypocentral distance which are appropriate for the building site under consideration. The approach taken herein is parallel in concept to that proposed by Newmark and Rosenblueth [3.5] in that a hard-rock velocity spectrum is established from the maximum acceleration, velocity and displacement that is expected at the site. Figure 3.20 shows how a hard-rock spectrum is defined in terms of:

A_r = maximum hard rock acceleration (g)

V_r = maximum hard rock velocity (in/sec)

D_r = maximum hard rock displacement (in)

Therefore, in order to define a spectrum, a relationship must be established between the Richter magnitude (M) and hypocentral distance (r) and the maximum bedrock acceleration (A_r), velocity (V_r) and displacement (D_r). Such relationships are commonly referred to as attenuation relationships.

Donovan, see [1.4], has presented a survey of several attenuation relationships. The approach used herein is based upon the relationship between the site Modified Mercalli Intensity (MMI) and the site Richter magnitude and hypocentral distance, see equations (3.4.2) and (3.4.3). Also using El Centro and Ferndale earthquake data it can be shown [3.18] that the maximum soil particle velocity (V_s) can be expressed in terms of MMI using the following equation

$$\log_{10} V_s = -1.973 + 0.375 \text{ MMI} \qquad (3.4.22)$$

When taking into account the soil conditions at the El Centro and Ferndale sites it follows, see [3.20] and [3.21], that the hard-rock particle velocity, V_r, and the site Richter magnitude and hypocentral distance are related by the following equations.

Western United States (longitude $\geq$ 105°)

$$\log_{10} V_r = -1.625 + 0.563M - 1.403 \log_{10} r \qquad (3.4.23)$$

Eastern United States (longitude < 105°)

$$\log_{10} V_r = -2.062 + 0.563M - 0.979 \log_{10} r \qquad (3.4.24)$$

The cut-off longitude choice between the western and eastern regions of the United States is based upon:

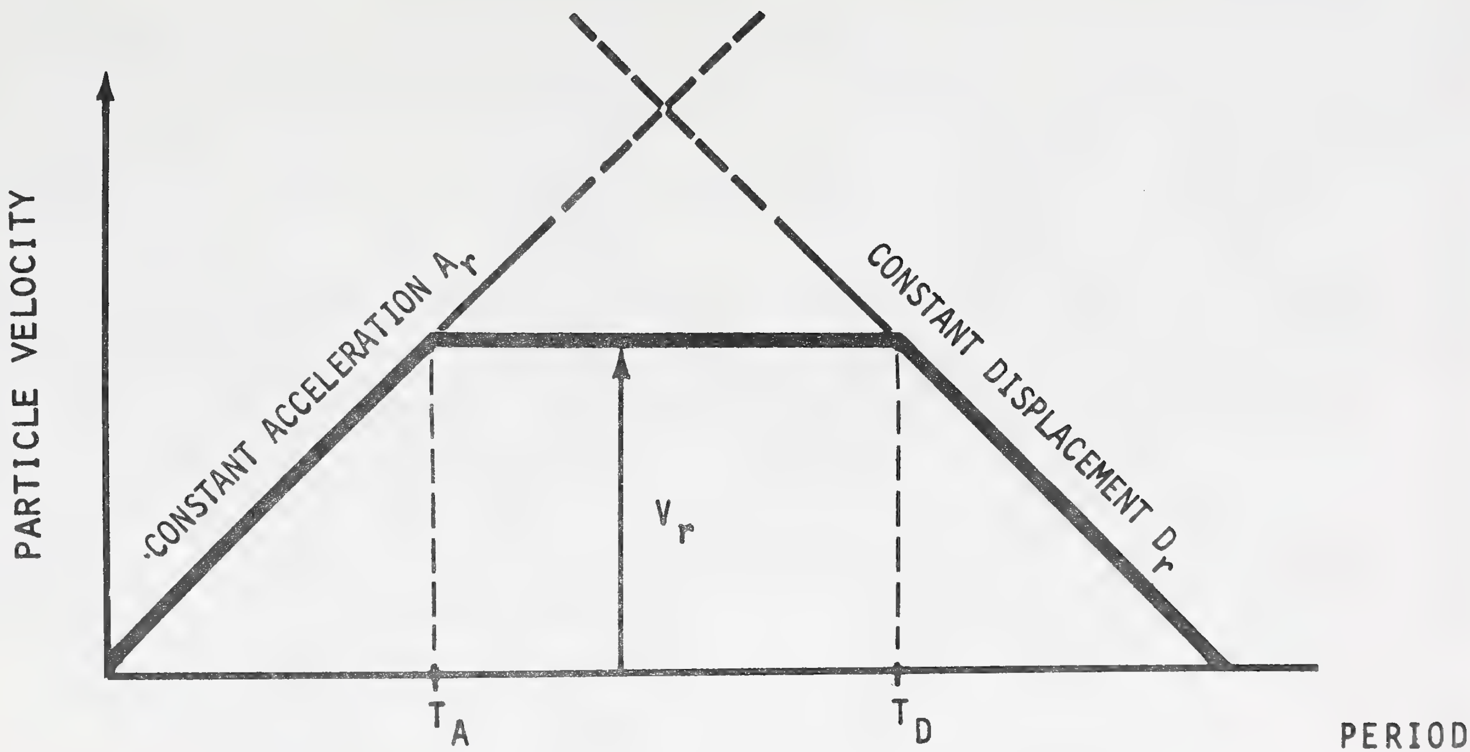


Figure 3.20 Hard Rock Velocity Spectrum on Tripartite Log-Log Plot

(1) the knowledge that the great plains regions ends at about 105° prior to encountering the Rocky Mountains [3.22],

(2) technical presentations by several seismologists at the May 1973 meeting of the Seismological Society of America.

Comparing the above attenuation equation with that derived by Nuttli [3.23] for the Central regions of the United States, one obtains -0.955 versus the value in equation (3.4.19) of -0.979. References [3.24 and 3.25] develop an attenuation relationship for particle velocity from underground nuclear explosive data in Nevada to be -1.39. This value agreed very well with the exponent -1.403.

Empirical evidence indicates that the maximum hard-rock acceleration and displacement are related to the maximum hard rock velocity. Figure 3.21 shows a plot of maximum hardrock acceleration and displacement versus velocity for the data in [3.18]. It is seen that the following relationships are appropriate:

$$\log_{10}A_r = -1.5675 + 0.7781 \log_{10}(V_r) \qquad (3.2.25)$$

$$\log_{10}D_r = -0.6144 + 1.1438 \log_{10}(V_r) \qquad (3.2.26)$$

Generation of Site Response Spectrum

The previous section discussed how a hard-rock velocity spectrum is established for a particular building site. This spectrum is amplified by the soil between the basement rock and the foundation of the building. In particular, expressing the site hard-rock velocity spectrum as a function of period using the notation

$V_{HR}(T)$ = site hard-rock velocity spectrum

then the site spectrum can be written as

$$V_{site}(T) = (DAF)_s \times V_{HR}(T) \qquad (3.4.27)$$

where

$(DAF)_s$ = soil dynamic amplification factor (in general also a function of period)

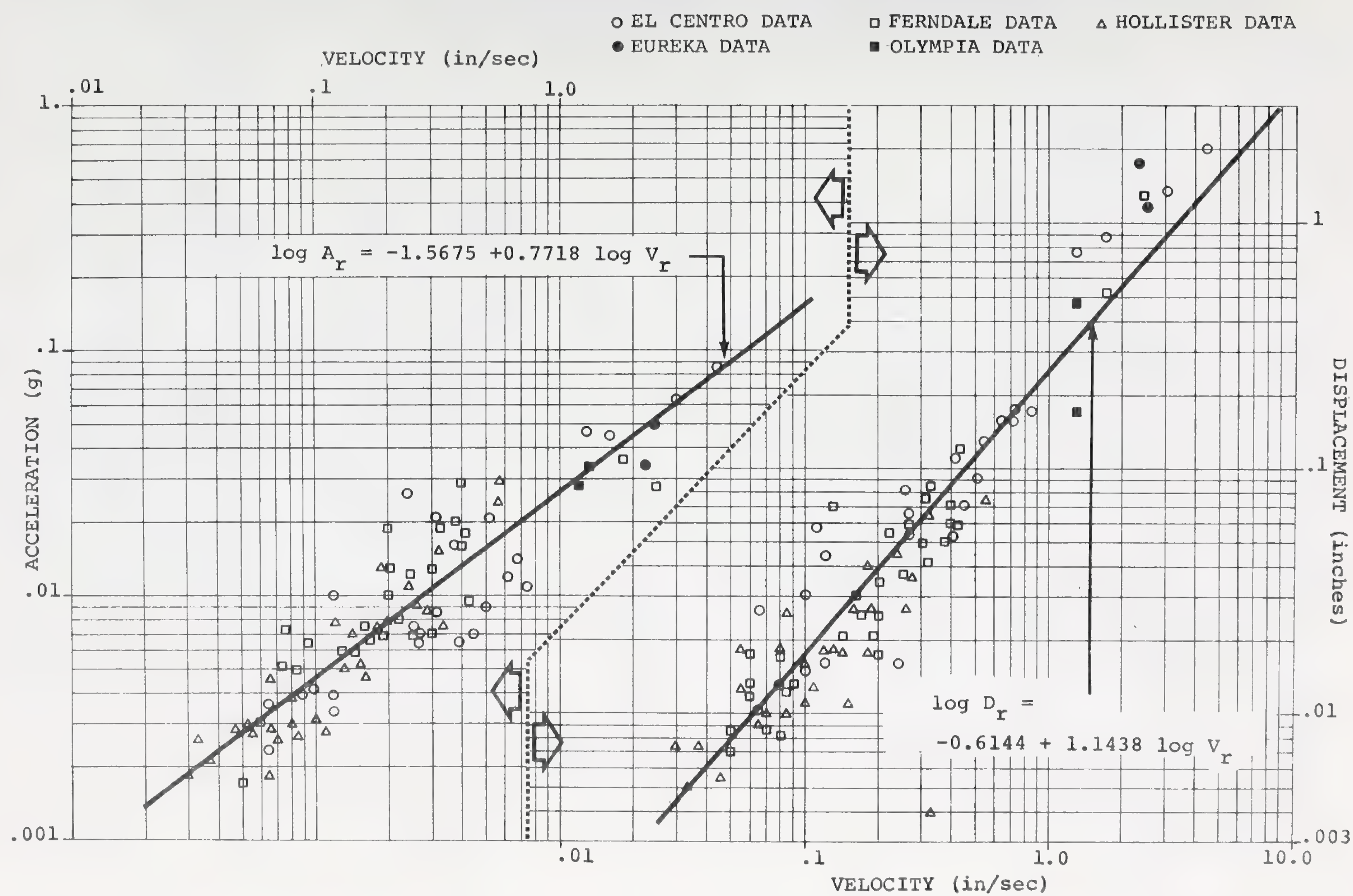


Figure 3.21 Acceleration Increases at a Lesser Rate Than Velocity Whereas Displacement Increases at a Greater Rate

The dynamic amplification factor of a site is a very difficult function to characterize. Opinions range from the idea that all sites give random characteristics, so it is impossible to model them, to the idea that all sites are very predictable in their dynamic behavior [3.24]. The computer program gives the user a number of options for computing this controversial property. The options are as follows.

Option No. 1: Complex

Reference [3.20] discusses a methodology employed for modeling the response of continuous, viscous damped, horizontally layered media to shear waves traveling vertically through the media. The theoretical development of this method is attributed to Sezawa and Kanai in 1931 and the soil response equation takes the form

$$\frac{\rho_n \partial^2 u_n}{\partial t^2} = \frac{\partial G_n}{\partial z} \quad \frac{\partial u_n}{\partial z} + G_h \quad \frac{\partial^2 u_n}{\partial z^2} + \xi_n \left(\frac{\partial^3 u_n}{\partial z^2 \partial t} \right) \tag{3.4.28}$$

where

G_n = shear modulus

u_n = displacement

ρ_n = density

Z = depth

h = layer number

t = time

ξ_n = damping factor

As noted in [3.20] this method is only valid for periods less than one second since surface waves, not shear waves, significantly influence the spectral magnitudes in the higher period regions. Also, if the soil layers extend to hard rock in deep sedimentary deposit areas, the amplification factors can significantly under estimate a site spectrum in both the low and high period regions.

Option No. 2: Semi-Complex

The second option is the same as No. 1 with the exception that each soil layer's shear wave velocity is calculated in the program using the results of conventional static soil properties as opposed to being measured in the field. The user must input for each layer:

(a) Damping of the layer (% of critical)
(b) Thickness (ft)
(c) Wet density (lb/cubic ft)
(d) Water content (% of dry density)

A discussion of the derivation of shear wave velocities from the above static soil parameters and a guide for the estimation of soil damping is presented in Appendix I of [3.11].

The remainder of the options presented herein calculate a soil amplification function which is independent of period. For this reason they are referred to as simple methods. The following options should only be applied when limited soil data are available.

Option No. 3: Simple Method (a)

Wiggins [3.20, 3.21] has developed the equation confirmed by Campbell and Duke [3.26],

$$(DAF)_s = \left(\frac{V_o \rho_o}{V_{SH} \rho_s} \right)^{0.5} \tag{3.4.29}$$

ρ_s = average density of site soil (lb/ft^3)

ρ_o = density of basement rock (lb/ft^3)

V_{SH} = average shear wave velocity of the site soil (ft/sec)

V_o = shear wave velocity of basement rock (ft/sec)

Under this option the user estimates soil density, layer thickness, and water content. From this data an approximate shear wave velocity profile is calculated in the program and the average values are used in equation (3.4.29).

Option No. 4: Simple Method (b)

If available dynamic data do not enable the use of Simple Method (a), but the static data are adequate for deriving site shear wave velocities (either for one or multiple layers of soil) then this option is to be used. Also, it is noted that this option uses equation (3.4.29).

Option No. 5: Simple Method (c)

Medvedev [3.27] has proposed an approach for calculating the site amplification which is essentially independent of period. His equation is given by

$$(DAF)_s = \left[\frac{V_o}{V_p} \right]^{.503} \times 10^{.301 e^{-.0037 h^2}} \tag{3.4.30}$$

where

V_o = P-Wave velocity of granite (basement rock) (ft/sec)

V_p = P-Wave velocity of site (ft/sec)

h = Depth to water table, (ft)

For various site characteristics, Medvedev [3.27] gives values for V_p, see table 3.8.

Table 3.8 MEDVEDEV'S VELOCITIES FOR P-WAVE [3.27]

Material	V_p (ft/sec)
Granite (basement rock)	18,383
Limestone and sandstone	10,856
Gypsum and marl	7,024
Rock debris and gravel	4,423
Sandy and clayey ground	3,618
Fill or soft soil	1,194

The values for h must be determined or estimated by the user in addition to the specification of the material under the site.

Option No. 6: Simple Method (d)

Reference [3.20] has suggested a method for computing the $(DAF)_s$ using equation (3.4.29) and knowing only the geologic description of the material to compute V_{SH}. The equation is

$$V_{SH} = 41.8\ (ZT)^{1/6} \tag{3.4.31}$$

where

Z = depth of deposit

T = age of deposit in years

Table 3.9 gives the ages of the materials that are specified to be located under the user's site [3.20].

Table 3.9 MATERIAL AGE VERSUS PERIOD

Era	Period	Age (x 10^6 years)
Cenozoic	Holocene	0.011
	Pleistocene	1.
	Quaternary	2.5
	Pliocene	16.
	Miocene	26.
	Oligocene	35.
	Eocene	43.
Mesozoic	Cretaceous	93.
	Jurassic	152.
	Triassic	175.
Paleozoic	Permian	192.
	Pennsylvanian	220.
	Mississippian	245.
	Devonian	284.
	Silurian	355.
	Ordovician	390.
	Canadian	415.
	Ozarkian	440.
	Upper Middle Cambrian	490.
	Lower Cambrian	515

C. Natural Hazard Loading - Wind

General Comments

The "fastest mile" wind speed is used as input to the wind load generation program. Caution must be exercised so as not to use published wind speeds based on averaging techniques that significantly differ from the "fastest-mile" wind speed determination since gust factors to be discussed in this section are dependent on the tvpe of velocitv data used to characterize the structural loading. Thus, the determination of a gust factor based on wind data from one averaging technique will not constantly describe random fluctuation about a mean wind velocity based on a fastest-mile averaging scheme.

Selection of Site Wind Speeds at 30 Feet Elevation

As the result of extensive work by Thom [3.28, 3.29, 3.30] using daily fastest-mile wind speed data from 141 open-country stations, extreme value statistics and instrument correction factors, annual extreme mile wind speeds for 2, 10, 25, 50 and 100 year mean return periods at various locations in the United States have been calculated. These data are presented in a form commonly referred to as Thom's maps. Figures 3.22 to 3.26 present the most recent of Thom's maps available at the time of this writing. The mean wind velocities are given only for a height 30 feet above ground. Table 3.10 presents Thom's wind data for Hawaii [3.30].

Although the physics of wind loading is indeed time dependent, at the present time demands of practicality preclude a dynamic approach. Instead, an equivalent static approach that uses a mean pressure distribution and gust factors is employed. The governing equation for the static approach is,

$$p = (1/2)\ C_p C_g \rho v_h^2 \left(\frac{H}{h}\right)^{2\alpha} \qquad (3.4.32)$$

where:

p = Equivalent static pressure intensity at height H (psf)

V_h = Fastest-mile wind velocity at 30 feet from Thom's maps (mph)

Figure 3.22 Isotach 0.50 Quantiles, in Miles Per Hour: Annual Extreme-Mile 30 Ft Above Ground, 2-Yr Mean Return Period [3.30]

Figure 3.23 Isotach 0.10 Quantiles, in Miles Per Hour: Annual Extreme-Mile 30 Ft Above Ground, 10-Yr Mean Return Period [3.30]

Figure 3.24 Isotach 0.04 Quantiles, in Miles Per Hour: Annual Extreme-Mile 30 Ft Above Ground, 25-Yr Mean Return Period [3.30]

Figure 3.25 Isotach 0.02 Quantiles, in Miles Per Hour: Annual Extreme-Mile 30 Ft Above Ground, 50-Yr Mean Return Period [3.30]

Figure 3.26 Isotach 0.01 Quantiles, in Miles Per Hour: Annual Extreme-Mile 30 Ft Above Ground, 100-Yr Mean Return Period [3.30]

H = height above ground (ft)

h = 30 feet

ρ = air density (at 15°C, 760 mm of mercury)

α = surface roughness coefficient

C_p = shape factor

C_g = gust factor at height H

Table 3.10 HAWAII FASTEST MILE DATA (mph) AT SEA LEVEL*[3.30]

	Return Period (years)				
	2	10	25	50	100
Leeward Exposure	38	51	60	67	75 mph
Windward Exposure	42	59	70	80	91 mph

*The following comment applies only to Hawaii. Since the data of table 3.10 is taken at sea level stations it must be converted to an equivalent fastest mile wind velocity at 30 feet above the ground for a site at an elevation Z feet above sea level. The user must do the following conversion before entering the data into the wind program:

$$V_{Z30} = V_{30}\left(\frac{Z + 30}{30}\right)^{1/7}$$

where

V_{30} = a velocity from table 3.10 (mph)

Z = elevation of site above sea level (ft)

V_{Z30} = new fastest mile wind velocity at 30 feet above ground for the site (mph)

Equation (3.4.32) applies to either a statistical or single-valued analysis of wind loading. The statistical analysis is done using Thom's maps for all return periods. For example, at some arbitrary site we find that Thom's maps yield the following information:

Return Period (years) (1/N)	N	Velocity (mph)
2 (figure 3.22)	0.50	V_1
10 (figure 3.23)	0.10	V_2
25 (figure 3.24)	0.04	V_3
50 (figure 3.25)	0.02	V_4
100 (figure 3.26)	0.01	V_5

Where N is defined as the number of times per year a wind with a speed greater than or equal to V_i (i = 1 to 5) occurs.

Plotting the above data for the hypothetical site on a semilog scale (see figure 3.27) allows the regression equation

$$\log_{10} (N) = C_1 - C_2 V_h \tag{3.4.33}$$

to be fitted to the data. The coefficients C_1 and C_2 are site dependent constant coefficients determined by a least squares linear fit of data of the type given in figure 3.27. Note the similarity between (3.4.1) and (3.4.33).

Equation (3.4.32) may also be used for a single value analysis of wind loading. This may be accomplished by using one value of V_h and solving directly for p, independent of the statistical approach. It is noted that V_h need not be derived from Thom's maps. The user may select a wind speed which is based upon a detailed local velocity study. Regardless of the source, V_h must be the "fastest-mile" wind velocity at 30 feet above the ground.

Site Wind Speeds at Various Elevations

Thom's maps only give the basic wind velocity at 30 feet above the ground. Therefore, a relationship must be obtained in order to find the distribution of velocity with height. The most important factor affecting the shape of the wind velocity variation with height is surface roughness.

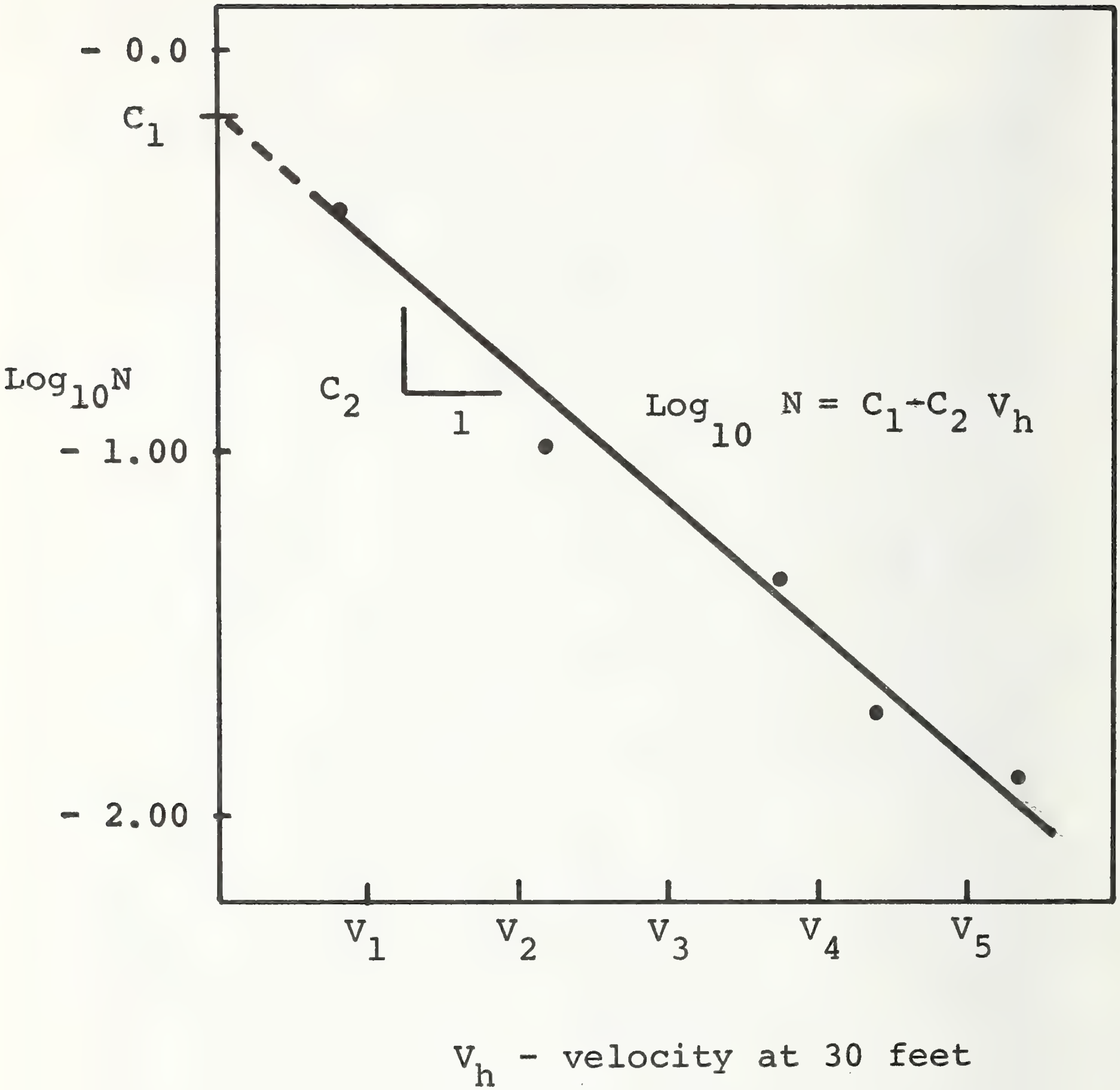


Figure 3.27 Regression Analysis of Wind Data From Thom's Maps for a Hypothetical Site

Surface roughness is the cumulative drag effect of buildings, trees, rocks, vegetation, etc., on the wind flow. Surface roughness does not include effects of local shielding of near-by objects. The variations of wind flow due to near-by ridges and valleys, etc., are also not included in the effects of surface roughness. Surface roughness is a minimum over the ocean and a maximum in a large city. Based upon the principles of fluid mechanics the mean velocity profile for turbulent flow at relatively low Reynolds numbers is described by,

$$V_H = V_o \left(\frac{H}{h} \right)^{\alpha} \tag{3.4.34}$$

If the reference velocity is taken at 30 feet, it then follows that equation (3.4.34) becomes

$$V_H = V_{30} \left(\frac{H}{30} \right)^{\alpha} \tag{3.4.35}$$

The exponent α incorporates the influence of surface roughness. Based on studies by Davenport [3.31, 3.32], as interpreted by Vellozzi and Cohen [3.33], the suggested exponents are given in table 3.11.

Table 3.11 POWER LAW EXPONENTS FOR VARIOUS TERRAINS

Description of the Terrain	Power Law Exponent (α)	Gradient Height (Z_g ft)
For open country, flat coastal belts, small islands situated in large bodies of water, prairie grassland, tundra, etc.	1/7	900
For wooden countryside, parkland, towns, outskirts of large cities, rough coastal belts	1/4.5	1200
For centers of large cities	1/3	1500

In table 3.11 Z_g is the height to the gradient velocity V_g, (the point above ground where the velocity distribution becomes uniform).

Gust Factors

The gust factor coefficient is used to describe the effects of random fluctuation of wind pressure about the mean wind pressure. The term "gust factor" is a relative one. A 10 second average wind is a gust on a 1-minute average wind while a 1-minute average wind is a gust on a 1-hour average wind. Thus, a measure other than duration should be used for a consistant evaluation of gust factors.

The method for the formulation of gust factors (C_g) in the wind load generation program is based on the work of Vellozzi and Cohen [3.33]. Several formulations of the gust factor C_g result in a single numerical value for a building [3.2, 3.32], however, the approach of Vellozzi and Cohen yields a gust factor which is a function of height and is also a function of the dynamic characteristics of the building and its surroundings. The details of the Vellozzi and Cohen gust factor formulation which is the method used in this procedure are given in [3.33].

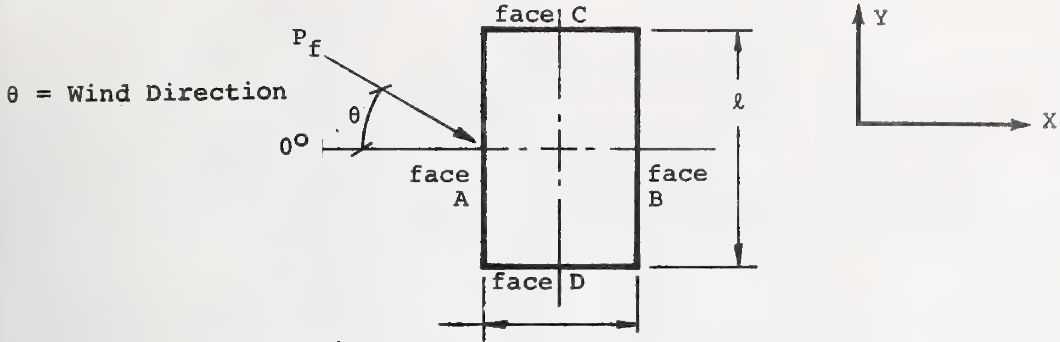
It has been emphasized that Thom's maps refer to a wind velocity in terms of fastest-mile wind. Vellozzi and Cohen's gust factor formulation, however, is in terms of a mean hourly wind velocity. The conversion of a fastest-mile wind velocity to a mean hourly wind velocity, is accomplished using a formula proposed by Vellozzi and Cohen [3.33]. Reference [3.33] uses gust factors for fastest-mile and mean hourly wind speeds and concludes that both sets of gust factors result in the same loading on the building. Thus, although gust factor formulation is dependent on type of wind data used, the quantity of interest - the loading - is essentially the same for both approaches.

A limitation of the gust factor formulation is that it applies to situations where the principal wind loading is drag. Other loadings induced by Von Karman Vortex shedding and by vortices shed from other structures are beyond its scope. Instability of the galloping and flutter types is also not included [3.32].

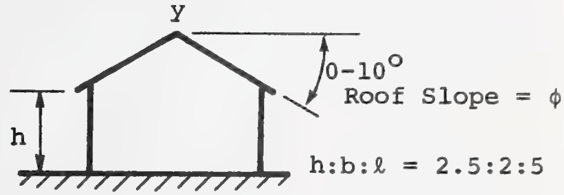
Shape Factors

The shape of a building in the wind stream greatly affects the distribution of wind pressure over the structure. The shape factor coefficients are designed to take into account the effects of the building's configuration on the wind stream flowing over, around, and through the structure.

The term "shape factor" is somewhat misleading in that it is not one number unique to one particular building. Instead it is made up of a series of pressure coefficients which, in turn, depend on the building's size and orientation in the wind stream. For example, figure 3.28 shows the pressure coefficients for a typical building and how these pressure coefficients go into calculating the shape factor in each building direction.



Plan View



Elevation View

Pressure Coefficients on Faces A,B,C,D

	Faces			
θ	A	B	C	D
0	.9	-.5	-.7	-.7
45	.5	-.5	.4	-.3
90	-.3	-.3	.9	-.3

(+) → Direct Pressure into face

(-) → Suction Away from face

Building Shape Factors

$(C_p)^x$ = (pressure coefficient on face A)-(pressure coefficient on face B)

= shape factor in x-direction

$(C_p)^y$ = (pressure coefficient on face C)-(pressure coefficient on face D)

= shape factor in Y-direction

Figure 3.28 Shape Factors and External Pressure Coefficients [3.35]

In 1958 the ASCE Committee on Wind Forces [3.34] presented its findings on wind forces on enclosed structures. Data from the ASCE, Swiss Building Code, [3.35], Danish Building Code and the University of Iowa were presented and discussed. Admittedly, the Swiss data based on wind tunnel tests were the best to that date in the ASCE's Review. As recently as 1968, McGuire [3.36] notes that the Swiss data is the most comprehensive for general use.

Since the Swiss data most efficiently describes the distribution of wind pressure and includes the effect of wind direction on the external loading, it is the procedure used herein for determining "Shape Factor Coefficients" in the wind load program. More study in this area is certainly needed, especially for turbulent flow on building structures.

Table 3.12 shows a sample of the structures that are included in the computer program for the calculation of "Shape Factors." A complete list of all structures is given in the Users Manual, see Appendix E. Note that the Swiss data are for specific building dimension ratios. In order to accommodate the user who may not wish to use the Swiss data, two additional options are provided from the ANSI Standards [3.2] for the calculation of "Shape Factors Coefficients." Thus, if the building under study does not satisfy the Swiss dimensional requirements, one may use the ANSI shape factors. If the user chooses, he may by-pass the shape factor available in the computer and input his own selected values for the shape factors.

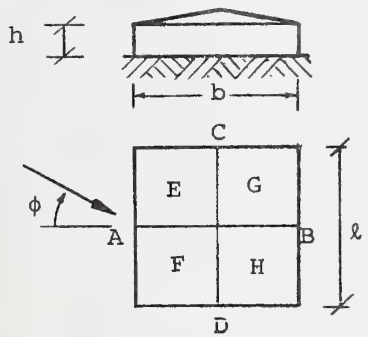
Internal Pressures

In addition to pressure loading on the exterior of the building, the wind stream flowing around the building causes changes in the internal pressure of the building depending on the amount and location of openings, i.e., windows, vents, etc. Figure 3.29 shows a typical set of internal pressure coefficients. Although internal pressures are present, their effect on the frame action of the building for all practical purposes is zero since the assumed uniformity of the change in internal pressure cancels in the specification of lateral frame loadings. Internal pressure coefficients are important in the design or analysis of individual walls, roofs and other local features.

Table 3.12 Building Identification by Code I Type Using Swiss [3.35] External Pressure Coefficients

ITYPE = Building Shape Code

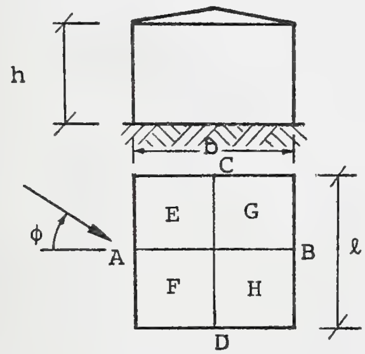
1 Gabled Roofs 0°-3°



h:b:ℓ = 1:4:4

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.3	-.4	-.4	-.8	-.8	-.3	-.3
45°	.5	-.4	.5	-.4	-.9	-.6	-.6	-.3
90°	-.4	-.4	.9	-.3	-.8	-.3	-.8	-.3

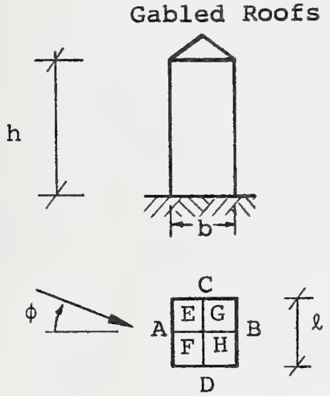
2 Gabled Roofs 0°-10°



h:b:ℓ = 1:1:1

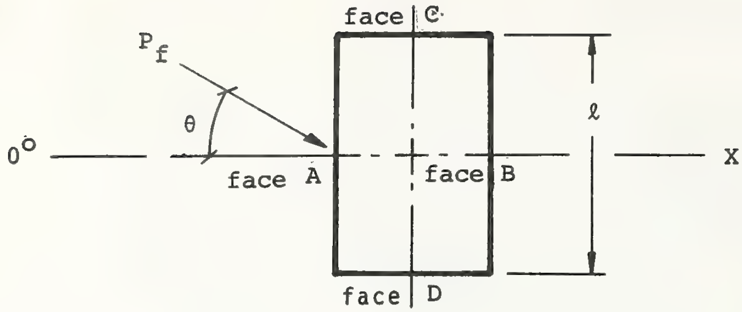
ϕ	A	B	C	D	E	F	G	H
0°	.9	-.5	-.6	-.6	-.7	-.7	-.5	-.5
45°	.5	-.5	.5	-.5	-.8	-.5	-.5	-.4
90°	-.6	-.6	.9	-.5	-.7	-.5	-.7	-.5

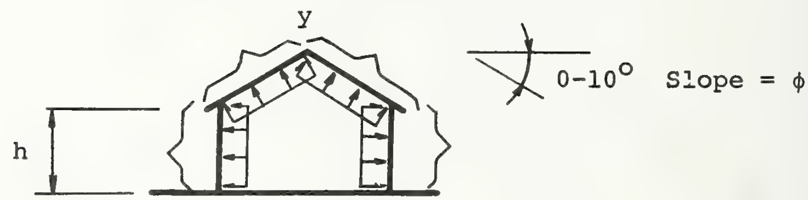
3 Gabled Roofs 0°-15°



h:b:ℓ = 2.5:1:1

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.6	-.7	-.7	-.8	-.8	-.8	-.8
45°	.5	-.5	-.5	-.5	-.8	-.7	-.7	-.5
90°	-.7	-.7	.9	-.6	-.8	-.8	-.8	-.8





Only Internal Pressure Shown

Internal Pressure Coefficients

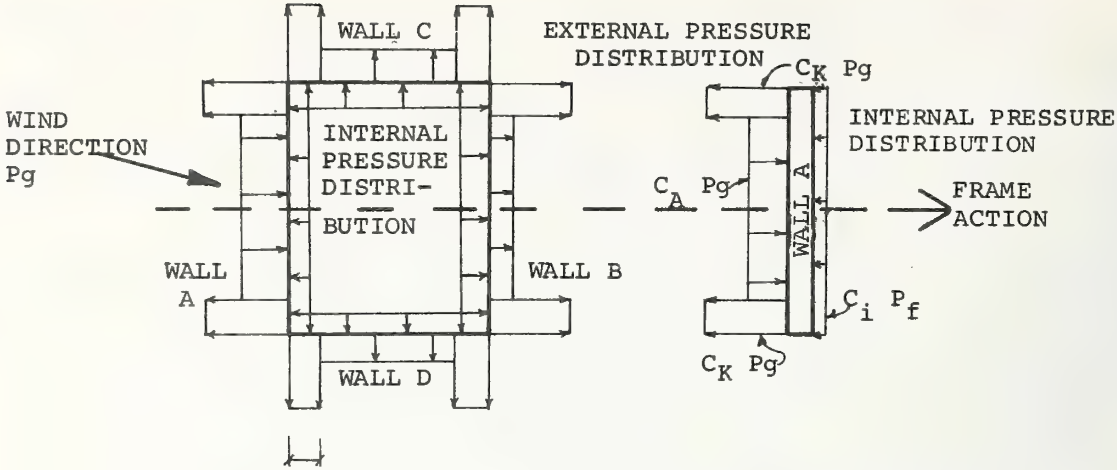
θ	Mainly Side A	Mainly Side B	Mainly Side C
0°	+.8	-.4	-.6
45°	+.5	-.4	+.3
90°	-.4	-.4	+.8

Figure 3.29 Internal Pressure Coefficients

The wind pressures calculated using equation (3.4.32) with a prescribed shape factor C_p are only appropriate for calculating gross frame response. This limitation is due to the neglecting of local wind pressure rises and internal pressure coefficients. When considering gross frame response the latter cancels and the former is assumed to be averaged out over the spacial extent of the structure.

The estimation of window damage caused by wind pressure is a function of the direction of the wind, exposure, external pressures and gust factors, and internal pressures. While frame response considers only wind loading along the line of action of the two-dimensional planar model, the estimation of window damage is based on wind pressures on all exterior walls of the building in a three-dimensional sense. To accomplish this, the external pressure distribution with height for each wall (windward, leeward and sides) is specified by use of the external pressure coefficients. Next, a determination of the internal pressure (or suction) coefficient is specified in terms of two parameters: the wall with the majority of the window area (windward, wall, leeward wall, side wall(s) or a uniform distribution) and a ratio of the open area to solid area of the wall with the majority of the openings. Internal pressures are assumed to be uniform on all interior surfaces at a given height. Note that while external pressures incorporate the effects of gusting, internal pressures do not, due to damping provided by restricted exterior openings.

Having now specified a distribution of external and internal pressures, the net pressure loading on the windows is determined for each wall. In addition, changes in local pressures at the corners of the buildings are considered. This analysis yields a net pressure distribution with height for pressure loading on windows adjacent to the corners within a region of one-tenth the least building dimensions. Thus, five net pressure distributions are determined for the three-dimensional analysis of window damage: four for the walls and one for the corners, see figure 3.30. The formulation of internal pressure calculations is consistent with ANSI A58.1-1972 recommendations [3.2].



PLAN VIEW OF i^{TH} FLOOR

(a)

FREE BODY OF WALL A IN PLAN

(b)

FREE BODY ANALYSIS OF WALL A (SEE b ABOVE)

CORNERS

$$-(C_K)\ Pg - (C_i)\ P_f = P_1$$

WALLS

$$(C_A)\ Pg - (C_i)\ P_f = P_2$$

where:

C_A = External pressure coefficient Wall A (Figure 3.28)

C_K = External pressure coefficient for building corners [3.35]

C_i = Internal pressure coefficient [3.35]

Pg = Pressure at i^{th} floor level approaching building with gust factor included

P_f = Pressure at i^{th} floor level approaching building without gust factor

P_1 = net pressure acting at the corners for window damage calculations

P_2 = net pressure acting on wall for window damage calculations

Figure 3.30 Specification of Net Pressure for Window Damage Calculations

D. Natural Hazard Loading - Tornado and Hurricane

General

The extent to which a building is damaged due to tornado or hurricane loads is a function of the user's specification of the wind velocity. The procedure utilized herein requires the user to specify the wind speed for a tornado or hurricane but presents guidelines to assist in the decisional process.

Tornado - General Comments

The Atomic Energy Commission has debated what the maximum tornado wind velocity is for a number of years and has arrived at an extreme velocity estimate of about 325 mph for computational purposes. Other estimates of tornado wind velocities range from 100 to 500 mph [3.37].

The design of buildings to resistant tornado forces and the accompanying problem of damage evaluation is perhaps the most complex problem discussed in this report. At the time of the writing of this report considerable research effort is being expended in the tornado risk area. Therefore, the procedure presented herein represents a first step. Prior to presenting the approach used herein, a few general comments about the current topics under study seems appropriate. First, the classification of tornadoes as to wind velocity, pressure drop and other intensity parameters is felt to be very important. At the present time only Thom [3.38] has presented a statistical analysis of tornado occurrence and his data does not distinguish between small and large tornadoes. The data only reflects the occurrence of a tornado. Serious attention is being directed at this intensity factor and it appears that one scale (called the FPP scale) will be adopted by NOAA. Second, the correlation between the numerical values of tornado parameter values must be more carefully studied before confident damage predictions can be made. For example, a statistical analysis must be made of parameter values such as rotational wind speed and pressure drop for a set translational tornado velocity. Certainly a correlation exists and it must have a significant statistical scatter which must be taken into account. Third, missle motion during a tornado needs and is receiving careful attention. Damage due to flying debris (often the debris is an automobile or a water tank!) is considerable and only after this topic has received considerably more study can such items as window damage be confidently predicted. The questions are many but research is progressing at an accelerated pace. This section discusses an approach which is state-of-the practice and by using it good general damage estimates can be obtained.

The recommended procedure for selecting a tornado wind speed for use in the detailed damage evaluation procedure involves the use of statistical studies conducted by Thom [3.38]. In particular, using historical data, Thom discusses the probability of a tornado hitting a particular building located within a 1° by 1° grid. This probability of hit is a function of grid area, tornado return period for the site and the tornadoes path area. Therefore, the user may for his particular building site evaluate the probability of the occurrence of a tornado during a structure's life or any time span he wishes and also by selecting the width of the tornado path establish what the maximum tornado wind velocity will be.

The user evaluates the wind pressure loading on a building due to a direct tornado hit by using the same loading program as discussed in section 3.4.C.

Tornadoes are usually accompanied by severe pressure drops at their centers which cause buildings to explode as well as deform, if entirely closed. The internal pressure models in the wind loading program would underestimate this effect for a direct hit since the internal pressures from the tornado would change as more and more windows failed. In the Detailed Analytical Evaluation Method, only external pressure effects from tornado winds are considered. The user should recognize this limitation when evaluating tornado damage results using this loading model. It is believed that to include the pressure drop factor would be inappropriate due to the present uncertainty in the assigned values of the tornado parameters. Similarly, post tornado damage inspections have not established this as the primary cause of damage.

An evaluation of the damage to a building that does not suffer a direct hit is presented with certain limitations. To accomplish such an analysis the user would use the general wind loading program discussed in section 3.4.C. For this analysis the user must specify a value of tornado wind velocity (this should be less than the wind velocity of a direct hit), assume a site exposure and make use of both internal and external pressure coefficients. This wind model approach suggested for the "fringe" areas is based on the design example in [3.37] for wind velocity only, and from information presented in [3.39] which presented a gradient velocity distribution with building height to describe window damage to the Great Plains Life Building, Lubbock, Texas.

Tornado - Probability of Being Hit by A Tornado

The selection of a tornado wind velocity should start by using the assumption of a Poisson process and evaluating the probability of non-occurrence of an event (in this case, not being hit by a tornado) using

$$p = e^{-LN} \tag{3.4.36}$$

where:

p = probability of not being hit by a tornado

L = lifetime of the building (years)

N = number of tornados per year hitting the site

$(1/N)$ = return period of tornado

It then follows that the probability of a structure being hit by a tornado is given by,

$$P_o = 1 - e^{-LN} \tag{3.4.37}$$

The parameter N is a function of the tornado statistics and is specified as [3.38]

$$N = \frac{\bar{z}}{A} f \tag{3.4.38}$$

where:

$\bar{z}$ = mean path area of the tornado, square miles

f = annual number of tornados per grid

A = area of the grid wherein the site is located, square miles.

Using a normal distribution for tornado path data from Iowa and Kansas tornados, Thom assigns a mean path area of 2.82 square miles. The area of the 1° grids of figure 3.31 is a function of latitude and longitude and may be found from geographical tables. For convenience, table 3.13 may be used to determine the grid area. Linear interpolation is suggested between values.

Table 3.13 AREAS OF 1° GRIDS (SQUARE MILES)

	Latitude of Middle of Grid					
	25°30'	30°30'	35°30'	40°30'	45°30'	50°30'
Area (square miles)	4300	4109	3887	3634	3354	2983

Substitution of equation (3.4.38) into equation (3.4.37) yields

$$P_o = 1 - e^{-2.82\ (Lf/A)} \qquad (3.4.39)$$

as the probability of a site being hit by a tornado.

The following are examples of how the tornado probabilities are computed:

Example 1 - Site A

Site: 41°N latitude

99°W longitude

f = 1.7 tornadoes per year (figure 3.31)

$A = 3634 - \left(\frac{0.5°}{5°}\right)(3634\text{-}3345) = 3606\ \text{mi}^2$ (table 3.13)

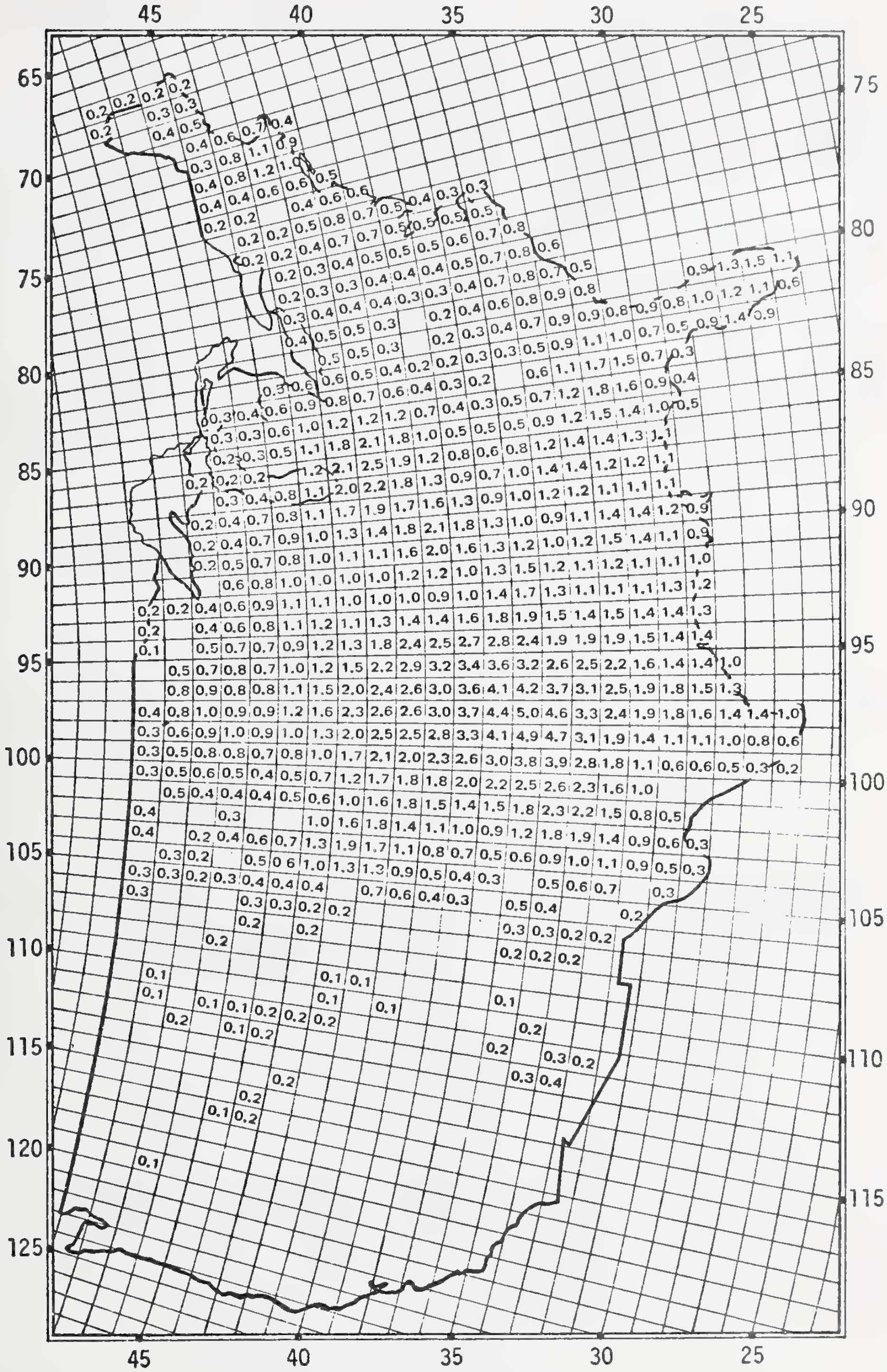


Figure 3.31 Mean Annual Frequency of Tornadoes 1953-1962, Parameter f [3.38]

L, Structure Life (yrs)	P_o, Probability of Site Being Hit by Tornado (%)
10	1.32
20	2.62
50	6.43
100	12.45

Example 2- Site B

Site: 30°30'N latitude
80°30'W longitude

f = 0.6 tornados per year (figure 3.31)

A = 3887 mi sq (table 3.13)

L, Structure Life (yrs)	P_o, Probability of Site Being Hit by Tornado (%)
10	0.43
20	0.87
50	2.15
100	4.26

Tornado - Selection of a Tornadoes Wind Velocity

Thom [3.38] has presented tornado occurrence frequency as a normal distribution and the area felt by a single tornado as log normal. Thus,

$$z_n = \left(\frac{1}{1760}\right) e^{\bar{v} + n\,\sigma_v} \tag{3.4.40}$$

where:

z_n = path area (square miles)

$\bar{v}$ = 8.51 = natural logarithm of the mean path area, [3.38]

σ_v = 2.057 = standard deviation of $\bar{v}$, [3.38]

n = number of standard deviations

The Thom data extends only to an $n = \pm 2.0$, thus, the maximum felt area observed is 172.6 mi^2 and the minimum felt area is 0.046 mi^2. The velocity of tornado can be computed as a function of the area covered. The engineering judgment that area and velocity are correlated stems from the idea that a large area of coverage implies a well-developed and stable tornado. A small area implies that the tornado is partially developed and somewhat unstable. That is, of course not true in all cases. However, the assumption is reasonable and allows one to compute a velocity knowing the path area.

Equating 200 mph velocity with the lowest level of tornado area observation and 325 mph with the greatest area observation, it is desired to find the coefficients C_o and C_1 which satisfy the following simultaneous equations:

$$\text{Velocity} = C_o \, (\text{tornado area})^{C_1}$$

or

$$\left.\begin{aligned} 200 &= C_o(0.046)^{C_1} \\ 325 &= C_o(172.6)^{C_1} \end{aligned}\right\} = \begin{aligned} C_o &= 240 \text{ miles per hour} \\ C_1 &= 0.059 \end{aligned}$$

Thus, it follows that the estimated tornado velocity as a function of the path area is:

$$V(T)_n = \text{Tornado wind velocity in mph}$$

$$V(T)_n = 240 \left(\frac{e^{\overline{V}} + n\,\sigma_v}{1760} \right)^{.059} = 2.40\,(Z_n)^{0.059} \qquad (3.4.41)$$

where $+2 \leq n \leq -2$

It follows that corresponding to equation (3.4.38) one obtains

$$N = \frac{Z_n f}{A} \qquad (3.4.42)$$

$$(1/N) = \text{return period} = (A/Z_n f)$$

Example 1 - Site A

$n = 1,0,+1$ (user selected)

for $n=+1$, $Z_n = 22.1$ mi^2, $(1/N) = 100$ yrs, $V(T)_n = 288$ mph

$n=0$, $Z_n = 2.82$ mi^2, $(1/N) = 750$ yrs, $V(T)_n = 255$ mph

$n=-1$, $Z_n = 0.36$ mi^2, $(1/N) - 5{,}900$ yrs, $V(T)_n = 225$ mph

Example 2 - Site B

$n = -1, 0, +1$ (user selected)

for $n=+1$, $Z_n = 22.1$ mi^2, $(1/N) = 290$ yrs, $V(T)_n = 288$ mph

$n=0$, $Z_n = 2.82$ mi^2, $(1/N) = 2{,}300$ yrs, $V(T)_n = 255$ mph

$n=-1$, $Z_n = 0.36$ mi^2, $(1/N) = 17{,}850$ yrs, $V(T)_n = 225$ mph

Hurricane Occurrence and Selection of Wind Velocity

Friedman [3.40] has recently developed statistics for hurricane occurrence and velocities similar to Thom's approach to tornado and wind. The maps thus prepared are produced in figures 3.32 to 3.35.

The user must first establish whether he is going to analyze the structure for a minimal, major or extreme hurricane. As shown in figure 3.32 this decision is directly related to the wind velocity. The figures present the number of times in the past 100 years that the noted sites experienced the various levels of hurricanes. If this number of times is denoted f_o then the hurricane return period is $(f_o/100)$ years. It is also assumed that unlike the tornado, the hurricane envelops the entire grid and therefore there is no area based reduction in the data given in figure 3.32.

In using figures 3.32 to 3.35, the tornado probability-of-occurrence methodology outlined earlier can be used; however, equation (3.4.37) becomes

$$P_o = 1 - e^{-\frac{L f_o}{100}} \qquad (3.4.43)$$

As an example, consider the New Orleans area. It follows from figure 3.32 that

Return period (75 mph $\leq V(H) \leq$ 100 mph) = 12.5 years

Return period (101 mph $\leq V(H) \leq$ 135 mph) = 25 years

Return period ($V(H) >$ 135 mph) = 25 years.

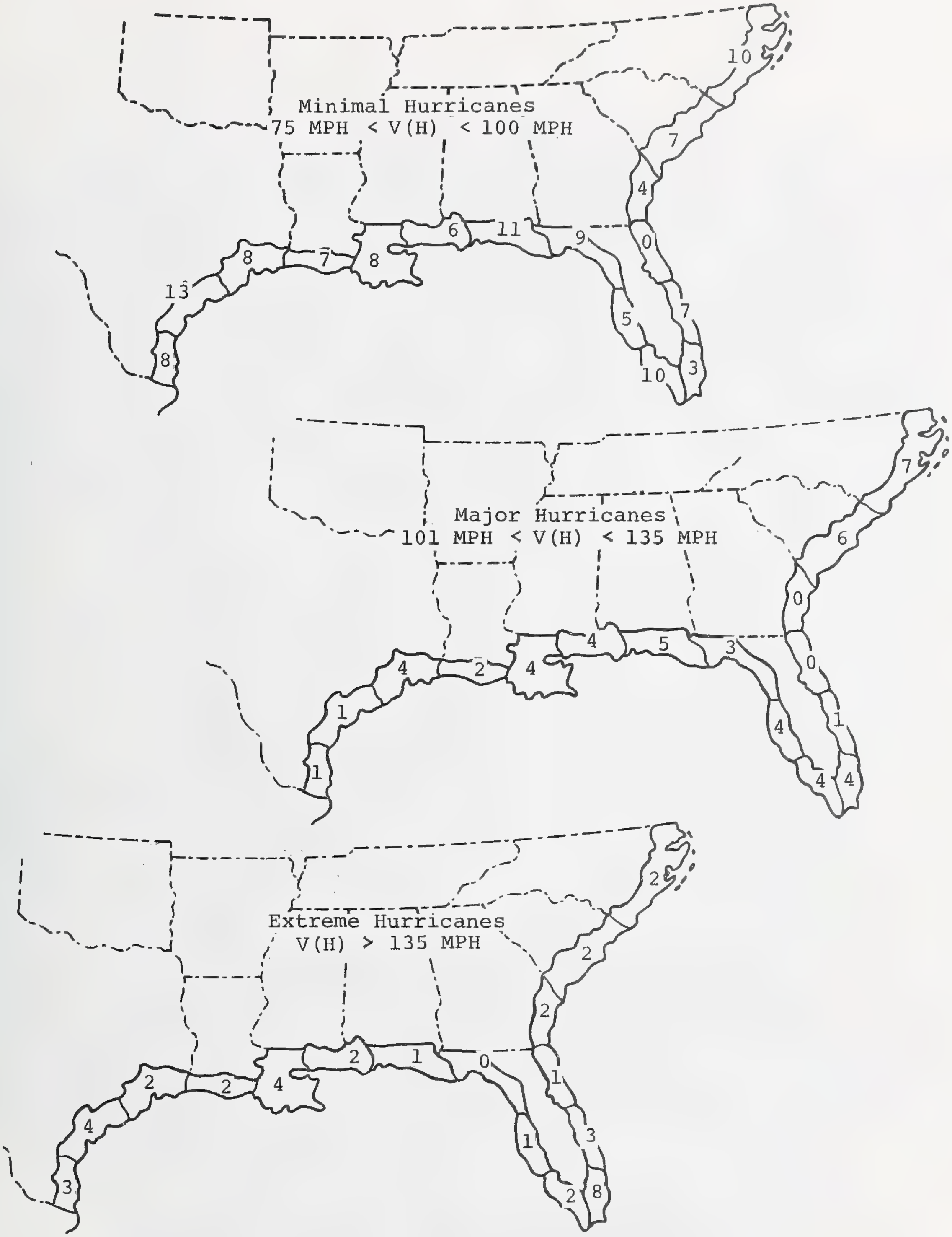


Figure 3.32 Number of Times in the Past 100 Years That Segments of the Coastline Were Affected By Minimal, Major and Extreme Hurricanes [3.40]

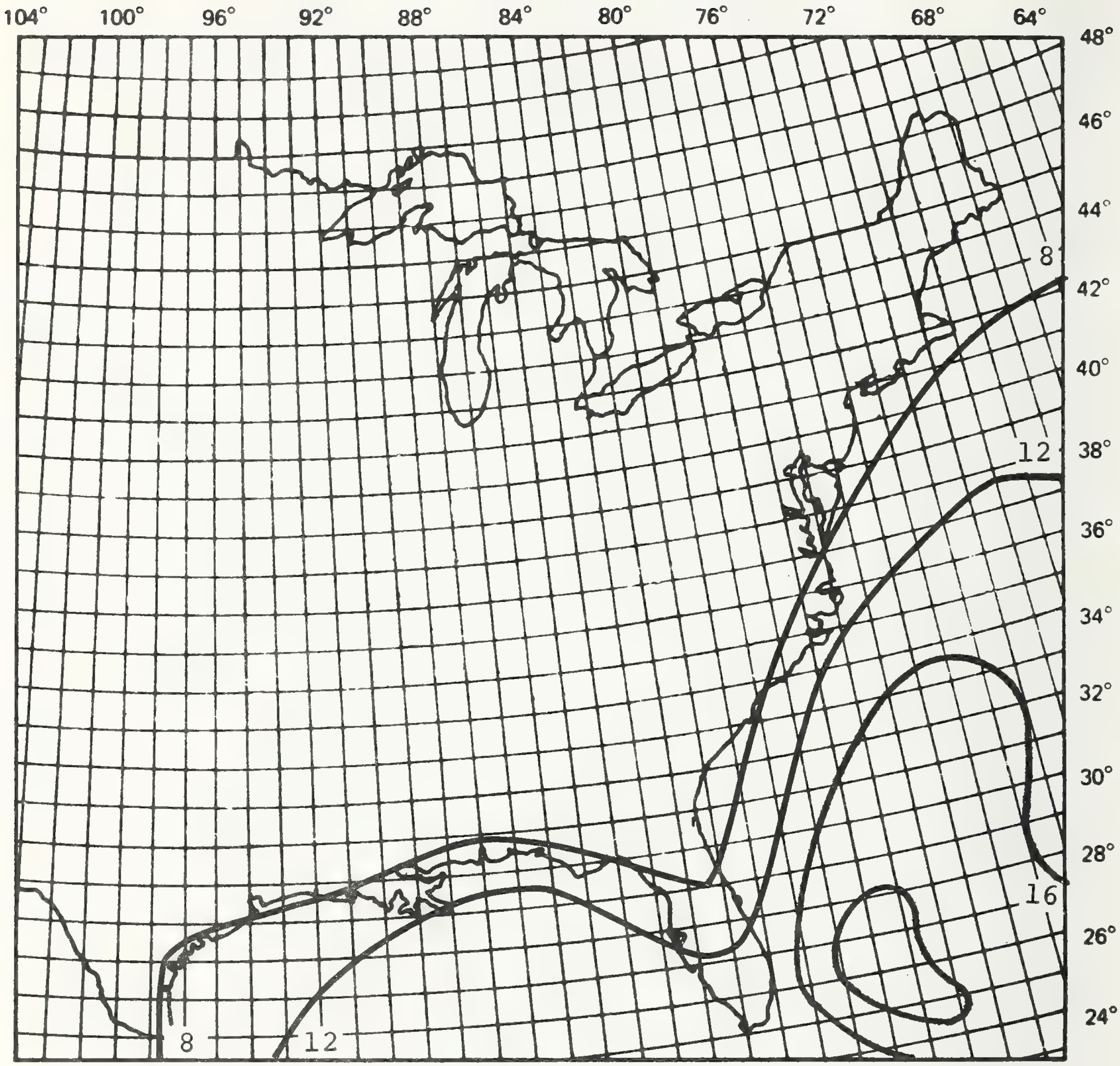


Figure 3.33 Number of Times in Past 100 Years, Path of a Minimal Hurricane (winds reaching somewhere between 75 and 100 mph sometime during the storm's life cycle). Passed through 1° Latitude by 1° Longitude Squares [3.40].

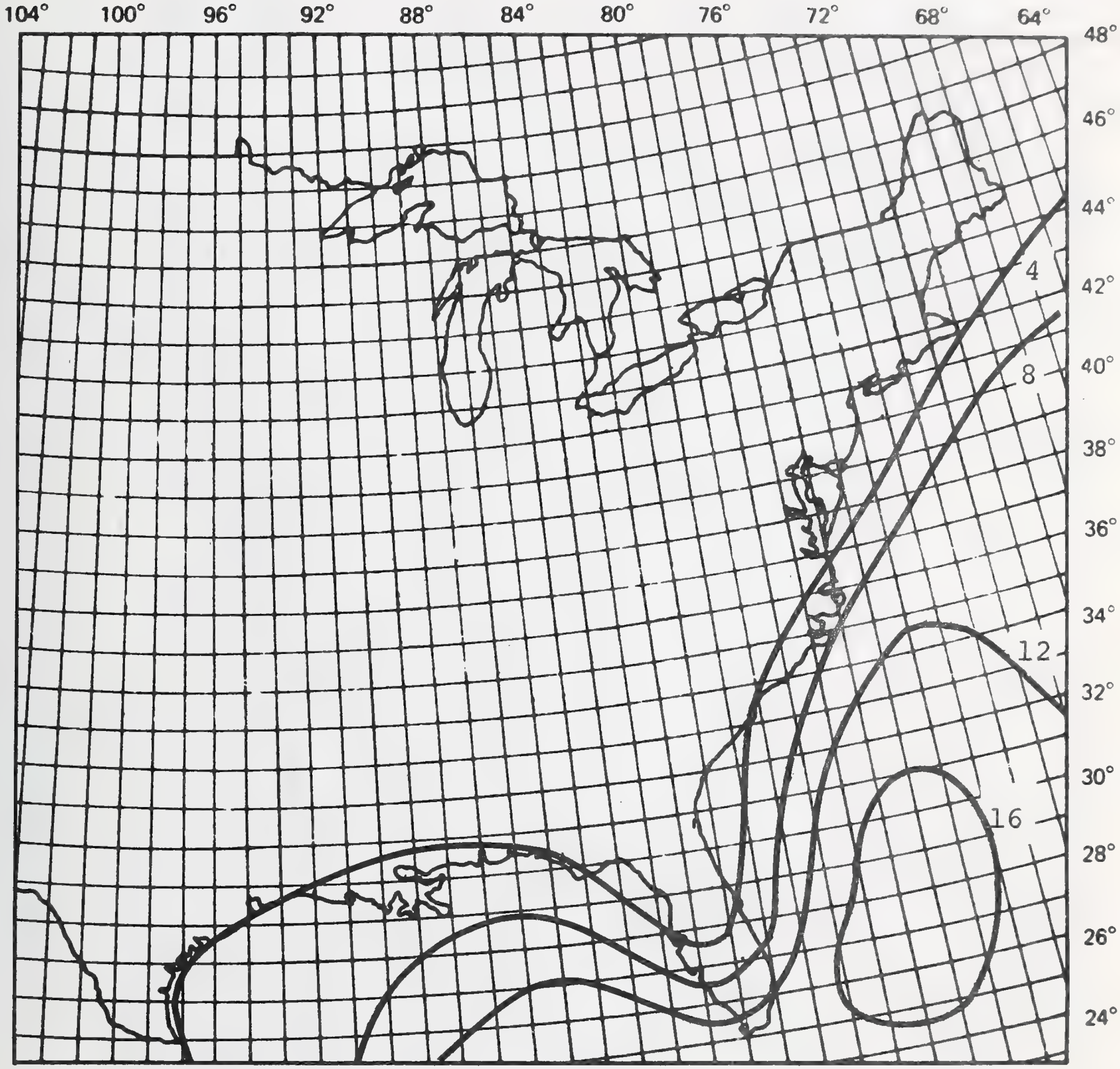


Figure 3.34 Number of Times in Past 100 Years, Path of a Major Hurricane (winds reaching somewhere between 101 and 135 mph sometime during the storm's life cycle) Passed Through 1 ° latitude by 1° Longitude Squares [3.40]

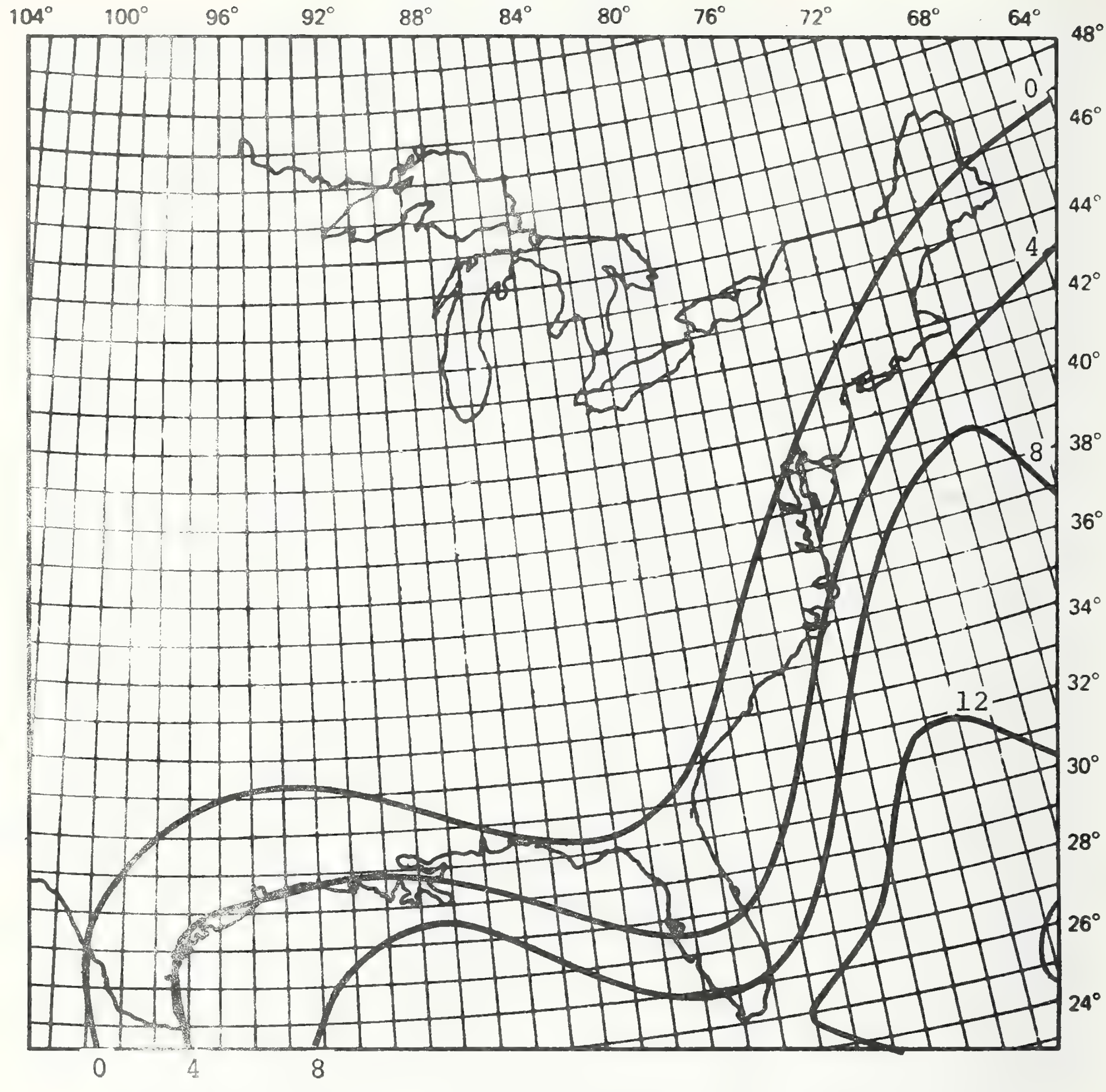


Figure 3.35 Number of Times in Past 100 Years, Path of Extreme Hurricane (winds reaching more than 135 mph sometime during the storm's life cycle) Passed Through 1° Longitude Squares by 1° Latitude Squares [3.40]

Since the hurricane data are presented over a range in velocity a kinetic energy balance is necessary to obtain a single numerical value for the velocity in each class. So doing it follows that:

minimal hurricane = 88 mph

major hurricane = 119 mph

extreme hurricane = 139 mph

The user must therefore be guided in his selection of the hurricane wind velocity by the site location, the severity of the hurricane expected and the structures life. Also, when using Friedman's maps to estimate loading due to hurricane winds the assumption of fastest mile of wind measured at 30 feet above the ground must be made for a consistent evaluation using the wind loading program.

E. Structural Characterization

This section presents several structural modeling options which are incorporated in the program. The program requires the user to select which option is appropriate for his particular problem. While later in this section insight is provided into how to make this selection, it is essential to point out that such a selection is often difficult, and no standard rules can be constructed. To think that one can computerize this selection process would be professionally naive because it fails to recognize the individuality exercised by the architect and structural engineer in the building design process. Therefore, while helpful suggestions are offered which are appropriate for a large general class of common buildings, it is important to note that the addition of a small amount of professional input at this stage of the damage prediction procedure by an experienced structural dynamist can produce a significant improvement in the accuracy of the final damage estimate.

Three general levels of detail are offered herein for structural dynamic modeling:

- A detailed model.
- A story-stiffness model.
- An empirical model.

It is noted that all of the modeling options lead to the same basic dynamic characterization: building natural frequencies and modal displacements. These characteristics are used in a manner to be described later.

Detailed Model

Two options are available for the detailed modeling of the building structure. Generally speaking, Option 1 is intended for steel frame type buildings and offers the user convenience in being able to specify standard framing members by code number rather than sectional properties. This option must be used whenever diagonal bracing is present. Option 1 allows for non-rigid joints in the building by permitting framing members to be pinned, with rotational springs inserted at joints to transmit moment.

Option 2 is intended for concrete buildings and must be used to model shear walls since Option 1 has no direct shear-wall modeling capability. Option 2 does not allow for non-rigid joints and does not accommodate diagonal bracing. Otherwise it can be used in place of Option 1. While the beam and column inputs for Option 1 are tailored for steel structures, those in Option 2 are tailored for concrete structures by allowing the user to input characteristic cross-sectional dimensions corresponding to rectangular, circular, I, box and T sections. It is noted that this option will handle buildings with combined steel or concrete frames and shear walls.

Both of the structural models use the stiffness method of structural analysis. Materials are assumed to remain linearly elastic over the range of response. All displacements are assumed to be small compared to the overall dimensions of the structure. All beams and column members must be prismatic and all connections which are not rigid are represented by rotational springs connecting pinned members.

The details of the analytical models are available in the published literature. In particular, for Option 1 the program follows the procedure presented by Lionberger and Weaver [3.41]. That procedure is an extension of an earlier procedure presented by Weaver and Nelson [3.42]. The program used in Option 2 follows the method proposed by Clough, King and Wilson [3.43]. In this method all beams are plane frame members with no axial deformations but with shearing and bending deformations, and all the columns or shear wall elements are treated as vertical frame members. Axial deformations are included for columns and shear walls. It is assumed that plane horizontal sections remain plane as the column or wall deflects. This model is usually referred to as the "deep beam" model for shear walls.

Story-Stiffness Model

The second general level of modeling is called the Story Stiffness Model. If selecting this option, the user must specify a weight, w_i, and a stiffness, k_i, for each ith story. The resulting homogeneous equations of motion for the building have a diagonal mass matrix with elements $m_i = w_i/g$ (g denotes the acceleration of gravity). The building stiffness matrix is banded and takes the form

$$[K] = \begin{bmatrix} k_1 & -k_1 & & & & 0 \\ -k_1 & (k_1+k_2) & -k_2 & & & \\ & -k_2 & (k_2+k_3) & -k_3 & & \\ & & -k_3 & (k_3+k_4) & - & \\ & & & -k_4 & - & -k_{n-1} \\ & 0 & & & & (k_{n-1}+k_n) \end{bmatrix}$$

The numbering convention is such that the stories are numbered from 1 to n, beginning at the top.

Using this method for estimating story stiffnesses the vertical framing members are assumed to deform such that their ends are constrained against rotation.

Empirical Model

The third level of modeling complexity involves the least user time to prepare input but is the least descriptive of the building under consideration. It requires only that the characteristic depth of a building and its height and/or number of stories be specified.

Various investigations and codes attempt to correlate empirical equations for first (fundamental) natural period (T_1) with measured data [3.44-3.49]. It has been the experience of researchers that no one equation can consistently estimate T_1. The variables to be considered are extensive and include: (1) amount, type and distribution of steel or reinforced concrete framing, (2) shear wall or shear wall and frame action,(3) rectangular, L-shaped or U-shaped plan dimensions, (4) the variation of mass and stiffness, (5) the influence of non-structural elements, (6) an assumed dynamic behavior, (7) the extent of soil-structure interaction, and (8) the level of excitation. In fact, regression equations built from data taken in one country, do not necessarily yield good period estimates of buildings in other countries.

Figure 3.36 shows the scatter of first mode period data plotted against the number of stories for U.S. frame structures [3.44, 3.50, 3.51]. Figure 3.37 shows the same trend for shear wall buildings as that for frame structures. All of the San Fernando earthquake data was obtained from reference [3.50] and [3.51].

These remarks serve to preface the suggested equations for estimating fundamental building periods. The equations for T_1 which are programmed are those recommended by the Structural Engineers Association of California (SEAOC) [3.6], see figures 3.36 to 3.38.

It is noted that the computer program allows the user to input estimates of a building's fundamental natural frequency obtained by any method, including his judgment. Reference [2.9] discusses some experience with using ambient building periods to estimate earthquake building periods.

Selection of Modeling Options

This section provides insight into the selection and usage of the previously discussed structural model. Model selection is usually based upon two underlying considerations: (1) economics associated with input formulation and (2) the modelability of the structure.

Certain buildings (e.g., modern steel or concrete frames with nonstructural partitions) may be accurately modeled using the detailed analytical model. That is to say that if such an analytical model is developed from the structural plans of the building to include each structural member, then the calculated values of the building's natural periods and mode shapes of vibration can be expected to represent observed behavior.

The engineer may wish an estimate of the building's dynamical properties for a building of the type described above, but may not wish to go to the man-hour expense of compiling and inputting to the computer the data required by such a detailed modeling approach. To answer this desire, the first level modeling option may be employed with the user inputting beam and column structural properties of each floor of a typical structural frame, or structural frame with averaged member properties (rather than representing each frame individually) in each building direction. The structural properties may be obtained in either of two ways.

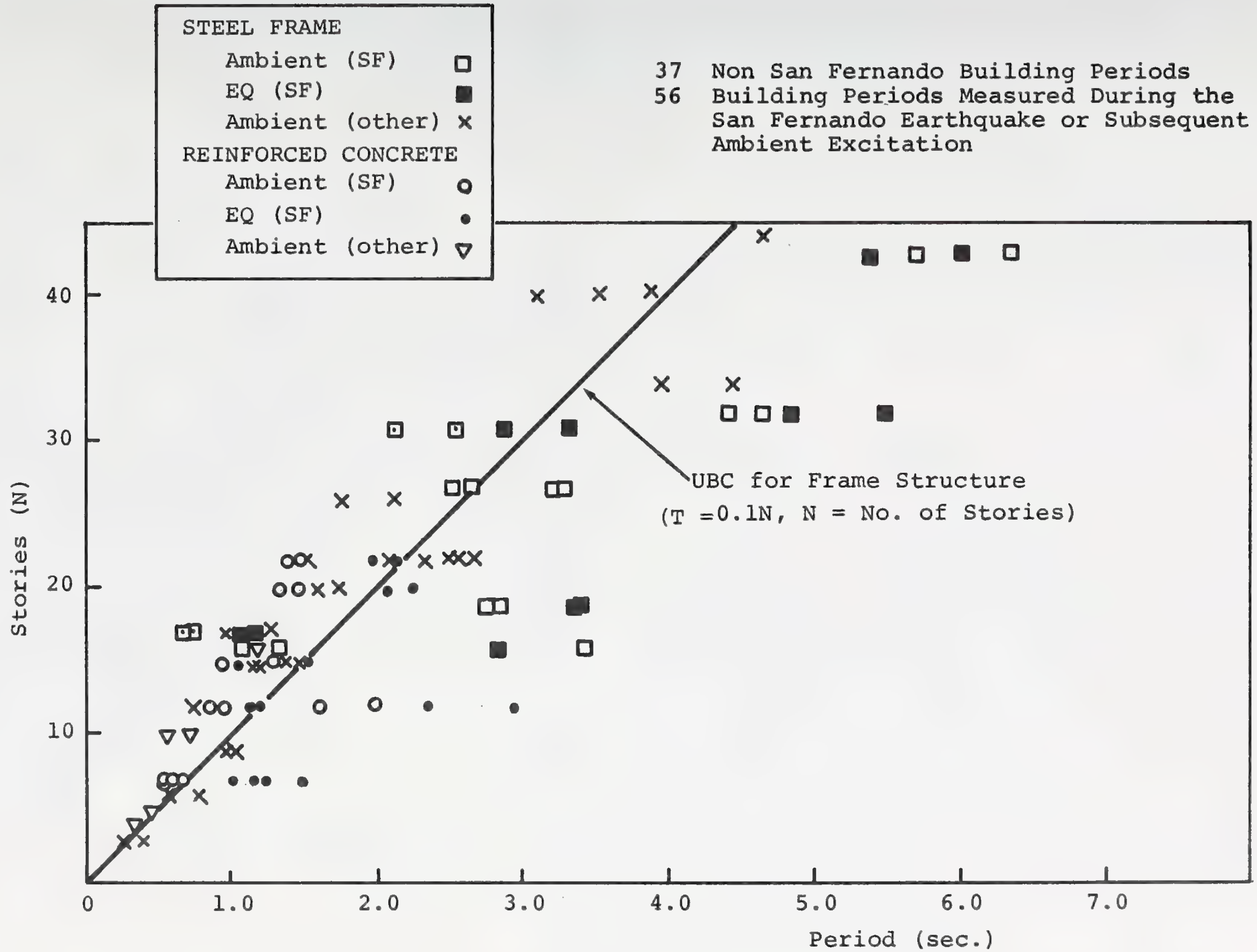
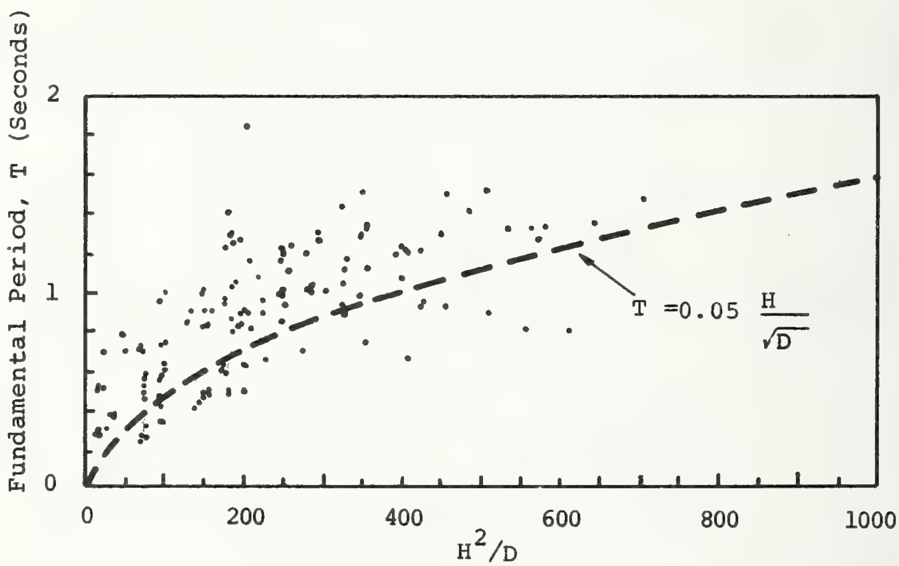


Figure 3.36 Period of Frame Structure Compared With UBC Estimator



H = Building Height (ft)

D = Building Depth in Direction of Vibration (ft)

T = Fundamental Period of Buildings

Data source - Ref. 3.49

Figure 3.37 Data Developed for Shear Wall Structures Relating to Period Plotted Together With UBC Code Value for T

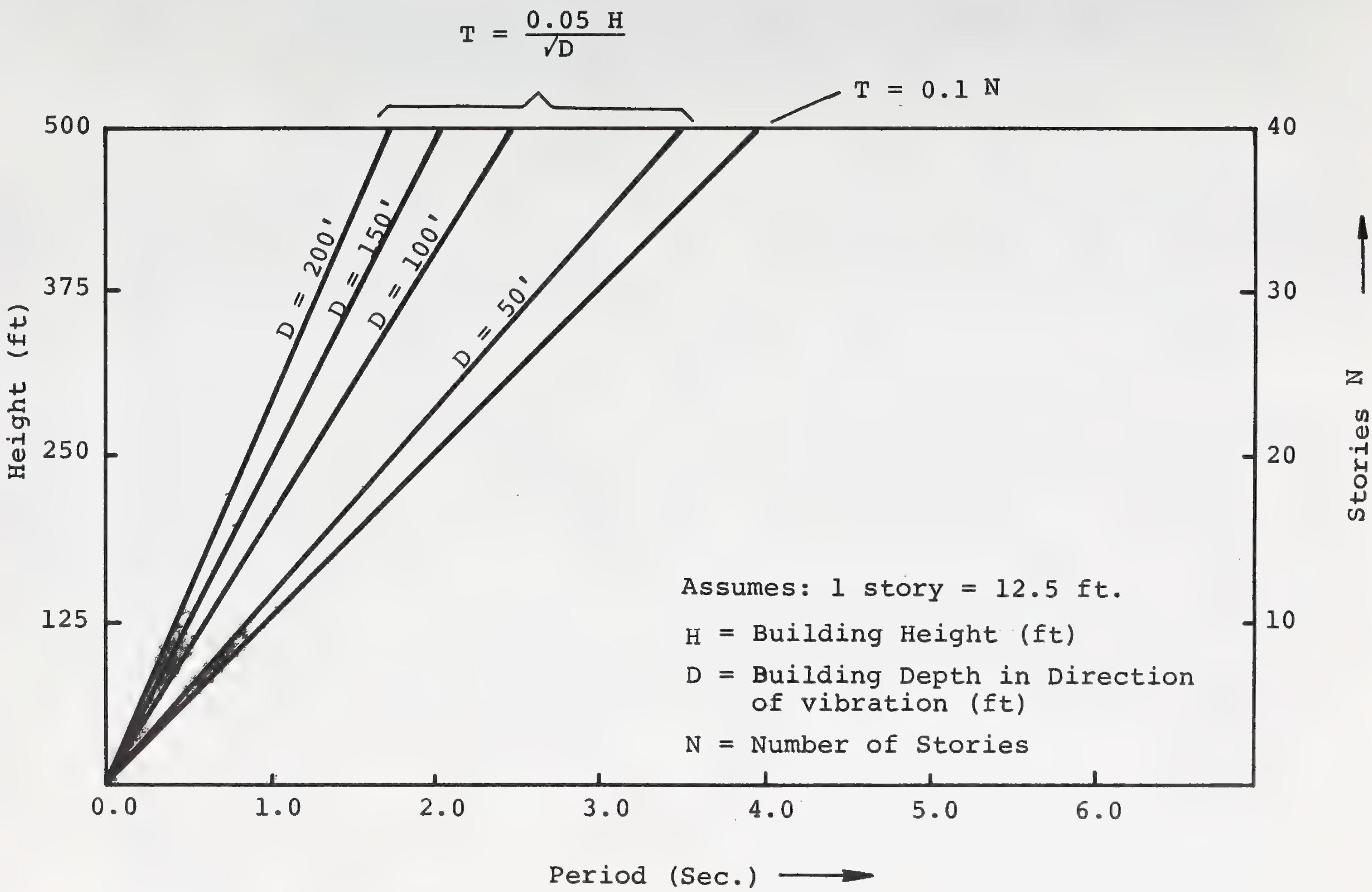


Figure 3.38 Recommended Period Estimations for Frame and Shear Wall Structures

One, an inspection of the structural plans will indicate the appropriate structural properties based on the building's particular framing system and professional experience. Two, a "walk-through" inspection of the building by an experienced structural dynamics engineer can provide rough approximations as to member sizes and hence structural properties for input to the detailed model. Of course, the "walk-through" approach is not recommended unless structural plans do not exist or time dictates its usage.

A second general class of buildings exist which possess partitions which certainly contribute significant lateral stiffness to the building frame. Examples of such partitions are concrete block or brick. To hope to accurately model a particular inhomogenous wall material using a shear wall analytical model may be unrealistic since the partitions are generally not continuous from floor to floor; yet some rational modeling technique must be used. The Story Stiffness Model is recommended for this case. This model requires the engineer to input to the computer program the resultant stiffness of the partition(s) plus frame at each floor. Estimates of these quantities must be made by the engineer. This model is particularly appropriate for low rise buildings which exhibit "shear-beam" behavior as opposed to "cantilever" or "bending-beam" behavior.

Certain buildings are so structurally irregular that the assumptions made to force them to fit into the first two levels of characterization would cause an analytical misrepresentation of their actual dynamic behavior. There also exist many old structures which were built prior to the enforcement of strict inspection procedures and quality control of materials and workmanship that are observed today. These same buildings might also have suffered prior structural damage which has since been masked by plaster and paint. To attempt to characterize such old buildings with an analytical model that inherently assumes adequate construction procedures and no prior damage would be an exercise in futility. In order to permit some sort of rational analysis of the above mentioned structures standard code type formulas are considered to be adequate to estimate their dynamic properties within the framework of the limitations imposed. An alternative to code formulas and certainly recommended would be to conduct full scale testing of the structures for the determination of dynamic and static properties from the measured data. <u>Such a task should certainly be done prior to any building modification dictated by the results of a damage evaluation study.</u>

F. Structural Response

Response to Earthquake Loading - General Comments

The site motion response spectrum for a building site obtained as discussed in section 3.4B is used to calculate maximum seismic response. The user may elect not to use this procedure and the option has been provided for input of any site motion response spectrum. The proposed procedure for calculating building response is a response spectrum approach. A procedure is used wherein damping variations with response level can be accounted for in the analysis. Also, the user of the computer program may, if he desires, with an input option incorporate modifications in the building response spectra which approximate the building's non-linear response behavior. Also, with this option the building's natural periods of vibration are modified based upon the amplitude of interstory displacements.

In order to provide an overview the following steps give a general picture of the response computation procedure which has been programmed.

(1) Calculate building natural periods and mode shapes of vibration.

(2) Set ductility equal to unity for the first response iteration.

(3) Compute modal damping for a building ductility level of one.

(4) Modify base motion response spectra for damping.

(5) If user desires, modify damped structural response spectra for ductility level greater than unity.

(6) Calculate building maximum interstory displacements.

(7) Evaluate the effective building ductility.

(8) Calculate building damping based upon ductility evaluated in (7).

(9) Repeat Steps (4) through (8) until damping and ductility converge.

(10) Calculate maximum values of building response parameters for damage evaluations.

The response spectrum approach for evaluating modal contributions to total dynamic response has been found to yield reasonable engineering approximations in the case of buildings subjected to base excitation [3.5 , 3.52]. The response quantities used in predicting damage include the following:

- Floor acceleration
- Floor velocity
- Interstory displacement

The computer program allows the user to choose any one of three options for calculating spectral response. The options are:

- Fundamental Mode Response
- Root-Sum-Square Response (RSS)
- Absolute Sum Response.

Response to Earthquake Loadings - Response Spectrum Amplification Factors For Damping

The value of structural damping has an effect on the amplification of the basement response spectrum. Figure 3.39 shows a plot of the amplification factor versus damping for each of three regions of the response spectrum. Inspection of this figure leads to three observations. First, amplification is greatest for systems with lower periods. Second, as the damping increases beyond ten percent critical the slope of the amplification plot becomes small and an increase in damping value has relatively little effect upon response maxima. Third, at twenty percent damping all amplifications approach unity.

In reference [3.11] an analysis of 20 earthquake response spectrum, obtained from the California Institute of Technology [3.53], was performed for damping factors of 0, 2, 5 and 20 percent damping. The two horizontal components were studied and the results averaged. The earthquake records used were:

1. El Centro, May 8, 1940
2. Ferndale, October 7, 1941
3. Kern County, July 21, 1952
   (a) Pasadena
   (b) Taft
   (c) Santa Barbara
   (d) Hollywood Storage basement
   (e) Hollywood Storage parking lot
4. Eureka, December 21, 1954
   (a) Eureka
   (b) Ferndale
5. San Jose, September 4, 1955
6. El Centro, February 9, 1956
7. El Centro, February 9, 1956 aftershock

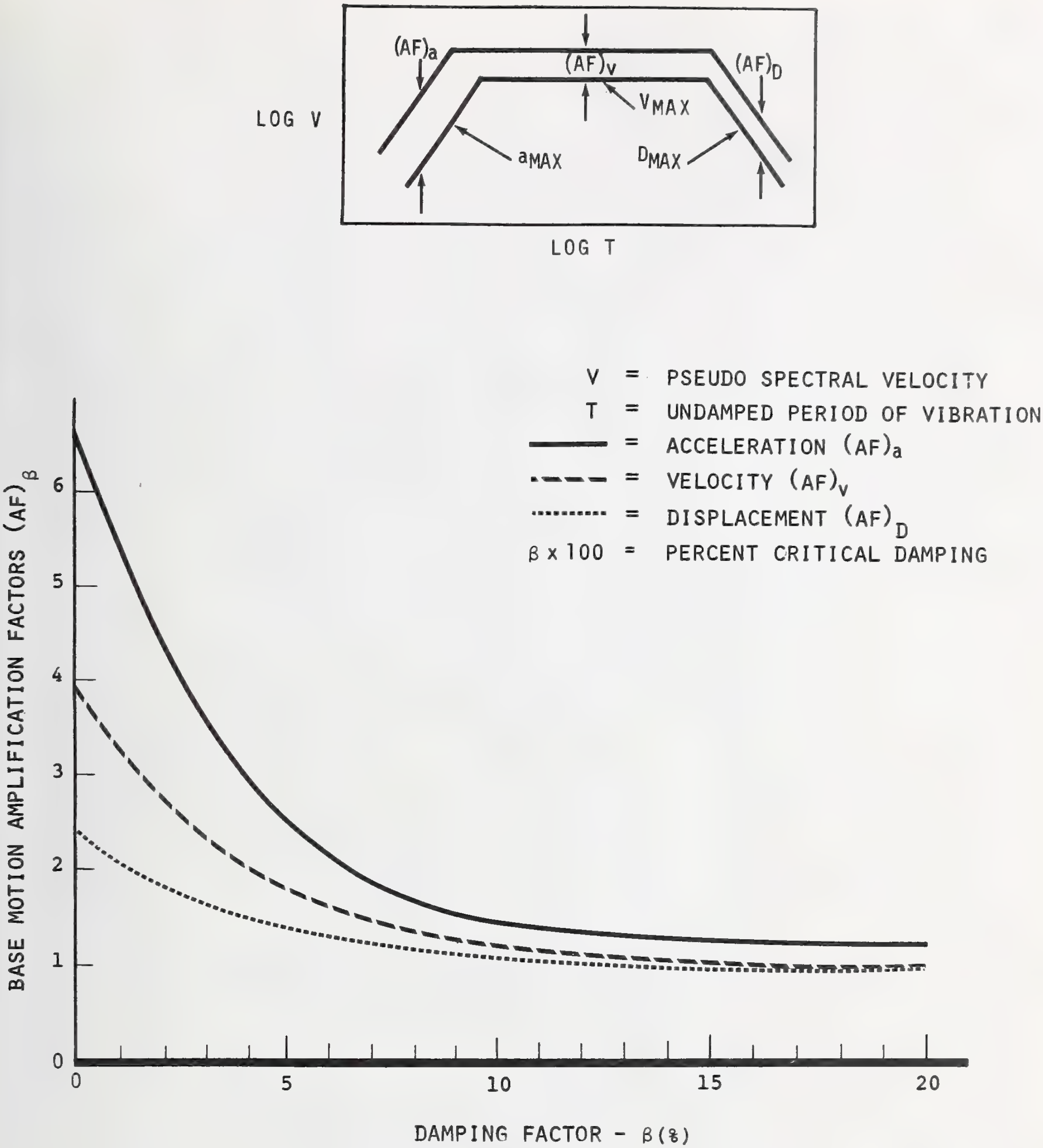


Figure 3.39 Base Motion Amplification Factors vs Various Grades of Damping (After Newmark [3.5])

8. San Francisco, March 22, 1957
   (a) Southern Pacific Building
   (b) Alexander Building
   (c) Golden Gate Park
   (d) Oakland City Hall
   (e) San Francisco State Building
9. Hollister, April 8, 1961
10. Borego Mountain, April 8, 1968
   (a) El Centro
   (b) San Diego

These earthquakes considered had magnitudes up to 7.7 and hypocentral distances up to 90 miles. The mean pseudo velocity amplification factors obtained from this study are shown in figure 3.40. It is apparent from this figure that a general trend exists for amplification as a function of both natural period of vibration and damping. A smoothing of the curves in this figure produces the following expressions for mean response amplification:

$0 < T_n \leq 0.2$ sec

$$(AF)_\beta = [2.18 - 0.147 \log_{10}(T_n) - 0.633 \log_{10} (\beta \times 100)] \qquad (3.4.44a)$$

$T_n > 0.2$ sec

$$(AF)_\beta = [2.28 - 0.633 \log_{10} (\beta \times 100)] T_n \qquad (3.4.44b)$$

where:

$(AF)_\beta$ = pseudo velocity spectrum amplification factor due to damping

$\beta \times 100$ = percent critical damping

T_n = undamped period of vibration

The amplification factor values exhibit scatter about the mean amplifications shown in figure 3.40. The Coefficient of Variation, C_v, for this sample set of 39 earthquake components was calculated and it is shown in figure 3.41.

The detailed analytical model computer program uses equation (3.4.44) to amplify the site spectrum.

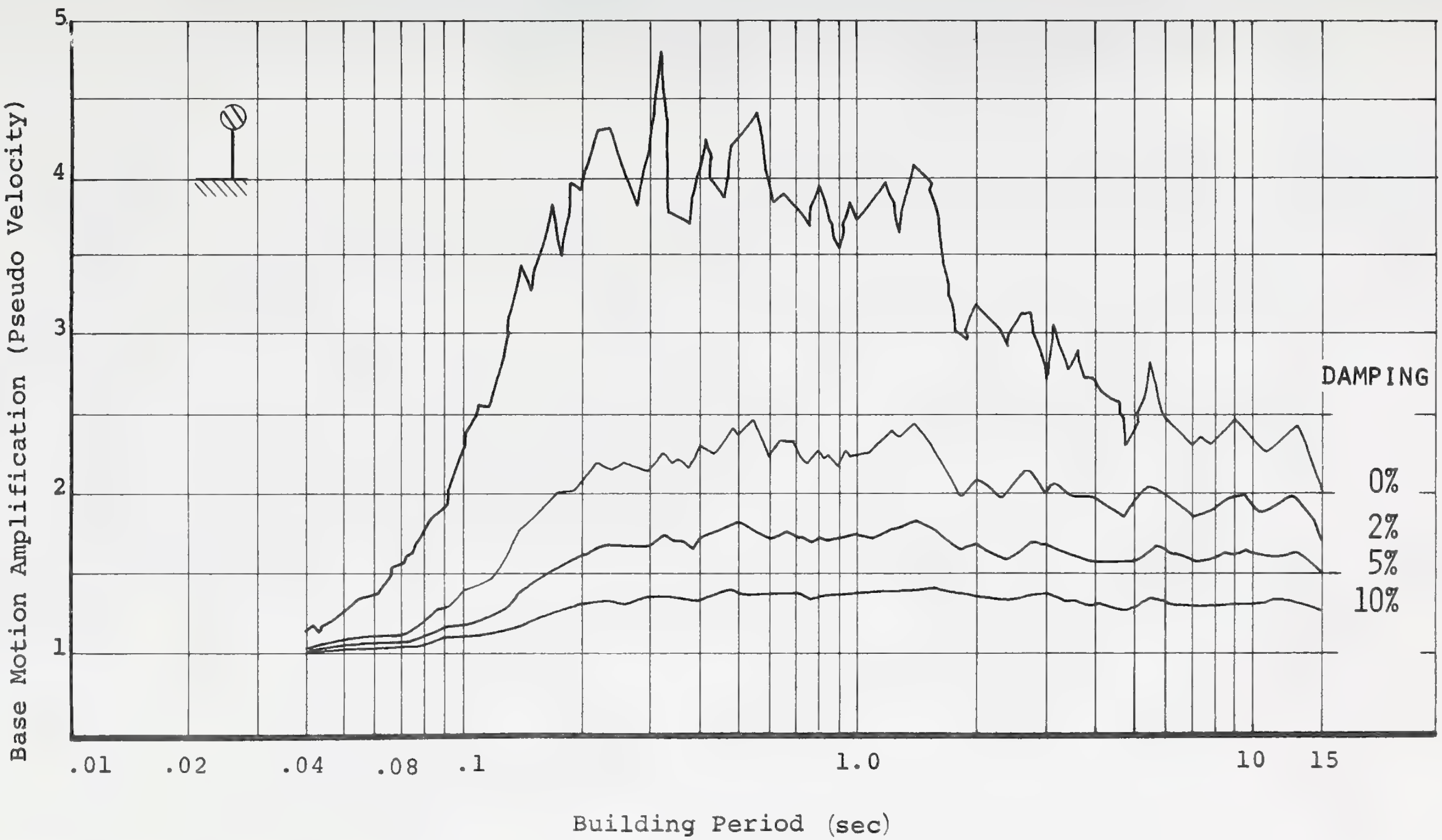


Figure 3.40 Mean Amplification $(AF)_\beta$ Relative to 20% Spectra for Horizontal Ground Shaking

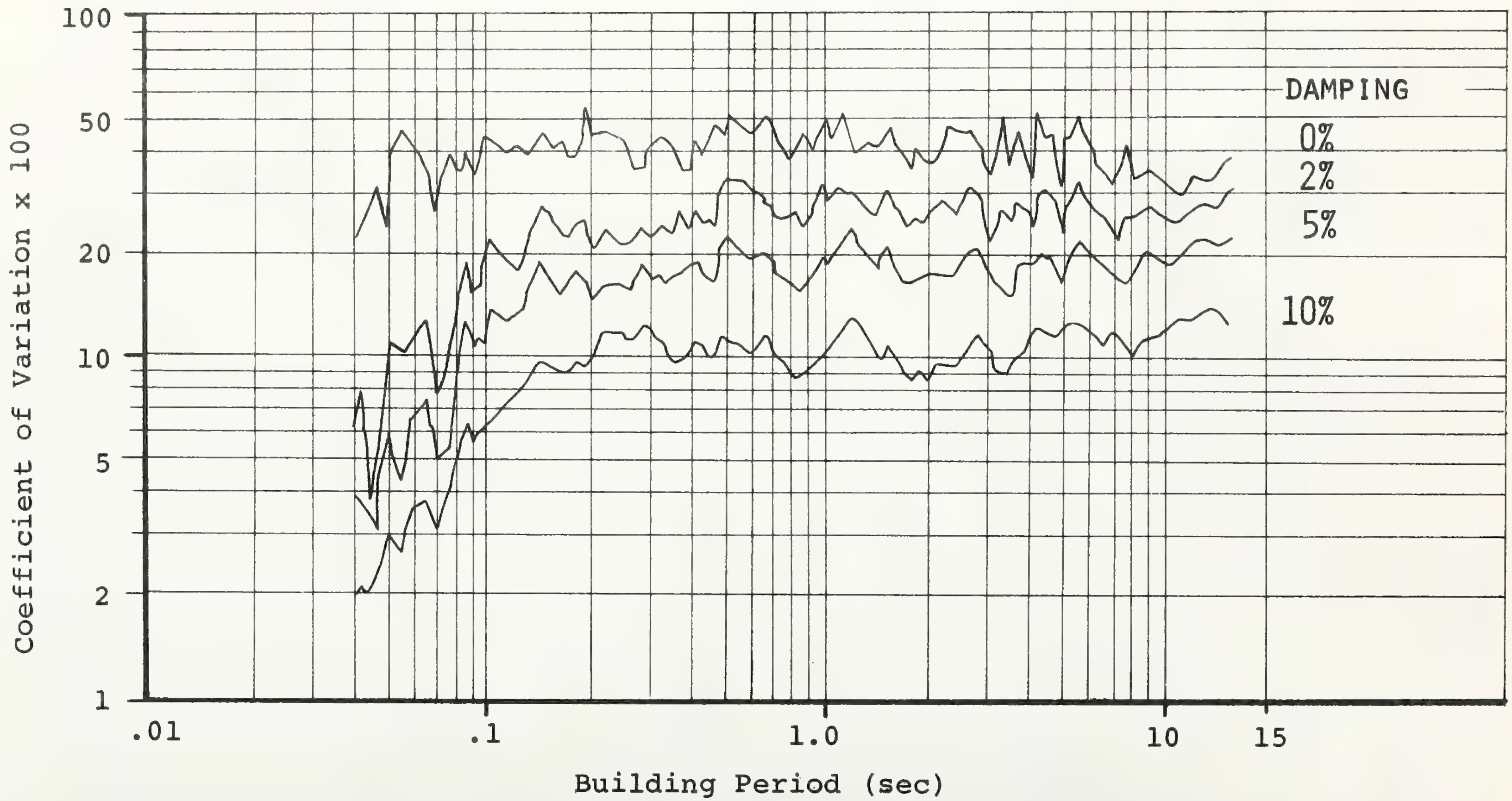


Figure 3.41 Coefficient of Variation of $(AF)_\beta$ for Horizontal Ground Shaking

Response to Earthquake Loading - Response Modifications for Ductility

Response spectra plots are obtained assuming that the building responds entirely in the linear elastic range. In order to extend its usage beyond the elastic limit several studies have been made [3.54 - 3.56]. These studies have been on elastoplastic single degree-of-freedom systems. For such systems a term called ductility, denoted μ, is defined to be:

$$\mu = \text{ductility} = \frac{(\text{maximum relative displacement})}{(\text{relative displacement at yield limit})}$$

Therefore, for all values of ductility greater than unity the structure responds beyond its elastic limit.

Comparisons made between response spectra computed for elasto-plastic systems and those computed for elastic systems reveal that the two are related by the ductility μ. This result provides a means of adjusting elastic response spectra to compensate for $\mu > 1$. The empirical equations recommended by Newmark [3.54] are given in table 3.14. Refer to figure 3.39 for definitions of $(AF)_a$, $(AF)_v$, and $(AF)_D$.

Table 3.14 DUCTILITY MODIFICATION FACTORS
(After Newmark [3.54])

Response Type Calculated	Pseudo-Velocity Amplification (AF)		
	Acceleration $(AF)_a$	Velocity $(AF)_v$	Displacement $(AF)_D$
Forces	1	$\frac{1}{\sqrt{2\mu-1}}$	$(1/\mu)$
Deflections	μ	$\frac{\mu}{\sqrt{2\mu-1}}$	1

Note that three factors are given depending upon which structural response parameter and spectral domain are considered. The domains are reflected by $(AF)_a$, $(AF)_v$ and $(AF)_D$ and correspond to amplifications of the same type as are shown in figure 3.39. Since Newmark's damping amplification factors are for use in design and hence are inherently conservative, the J. H. Wiggins Company has studied the spectral amplification factors in references [3.54 - 3.56] and have proposed adjustment parameters which reflect an average of the analytical study results. Table 3.15 presents these ductility modification factors and they are the ones used in the computer program.

Table 3.15 DUCTILITY MODIFICATION FACTORS FOR USE IN ANALYSIS

Response Type Calculated	Spectrum Adjustment Factors	
	$T < T^*_\mu$	$T > T_\mu$
Force	$1/\sqrt{\mu}$	$1/\mu$
Deflections	$\sqrt{\mu}$	1

$$^*T_\mu \equiv \frac{2\pi \text{ (Maximum Particle Velocity at Site)}}{\sqrt{\mu} \text{ (Maximum Particle Acceleration at Site)}}$$

In order to extend the use of these single degree of freedom results to multi-story buildings, an effective μ must be computed based upon the response of the building. This may be done by first forming an energy ratio of the maximum elastic strain energy computed from a linearly elastic analysis, to the energy capacity of the building when all floor interstory drifts are equal to the user prescribed yield interstory drift. If the vector $\{z\}$ represents the relative displacement vector associated with the former state, while $\{z\}_y$ represents that of the latter, then the energy ratio is given by

$$\left(\frac{E}{E_y}\right) = \frac{\{z\}^T [K] \{z\}}{\{z\}_y^T [K] \{z\}_y} \tag{3.4.45}$$

The square root of this ratio represents an average of the ductilities defined at each story and hence what is herein defined as the Effective Building Ductility. Such a ductility is defined as

$$\mu = \sqrt{E/E_y} \tag{3.4.46}$$

In the special case of a single story building,

$$\mu = \sqrt{E/E_y} = \Delta/\Delta_y \tag{3.4.47}$$

according to the usual definition.

Therefore, once a response state is established, equation (3.4.46) may be used to obtain an effective building ductility and then the appropriate values from table 3.15 can be utilized.

The modification of response spectra to incorporate ductility is an area of controversy. Besides the tentative assumption that the structure behaves in an elasto-plastic manner, it is important to recognize that only when the structure responds in a manner where one mode dominates the response that the ductility amplification factors cited in tables 3.14 and 3.15 can be used in a manner consistent with the way in which they were derived. It is recommended that future nonlinear design studies be undertaken to consider the response of actual multi-story buildings.

Response to Earthquake Loading - Amplitude Dependence of Damping

The variation of modal damping value with amplitude of excitation is understood to exist in buildings. Table 3.16 and figure 3.42 show two alternate forms of this amplitude dependence. Herein, damping is expressed as a function of effective building ductility using response data from the February 9, 1971, San Fernando earthquake.

The fundamental mode damping estimates cited in [3.50] were studied on a building by building basis and correlated with each building's effective ductility. This ductility was subjectively estimated using on-the-site damage estimates, computer response studies for the building, and estimated maximum building base shears during the earthquake compared with code design shears. The dots appearing in figure 3.43 represent these damping versus ductility estimates. Because of the considerable scatter in the data, only one curve is used to model the data and it was obtained using a least squares analysis of data for both steel and concrete buildings.

Table 3.16 REPRESENTATIVE DAMPING VALUES
(After Newmark and Hall [3.52])

Stress Level	Type and Condition of Structure	Percentage of Critical Damping
Low, well below proportional limit, stresses below 1/4 yield point	Steel, reinforced or prestressed concrete, wood; no cracking; no joint slip	0.5-1.0
Working stress, no more than about 1/2 yield level	Welded steel, prestressed concrete, well reinforced concrete (only slight cracking)	2
	Reinforced concrete with considerable cracking	3-5
	Bolted and/or riveted steel, wood structures with nailed or bolted joints	5-7
At or just below yield point	Welded steel, prestressed concrete (without complete loss in prestress)	5
	Reinforced concrete and prestressed concrete	7-10
	Bolted and/or riveted steel, wood structures with bolted joints	10-15
	Wood structures with nailed joints	15-20
Beyond yield point, with permanent strain greater than yield point limit strain	Welded Steel	7-10
	Reinforced concrete and prestressed concrete	10-15
	Bolted and/or riveted steel, and wood structures	20

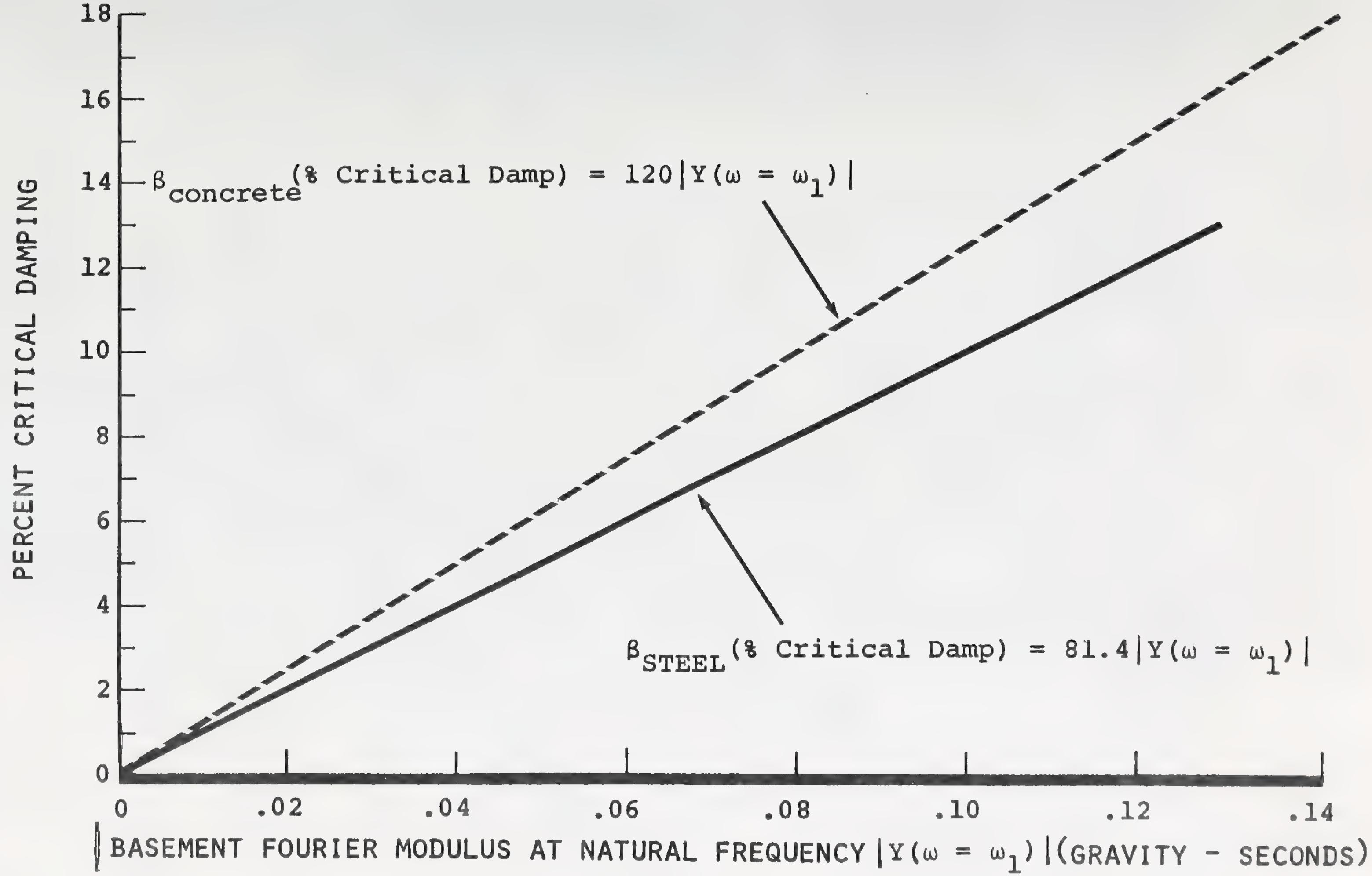


Figure 3.42 Building Damping in Fundamental Mode vs Amplitude (After Hart, Lew, Dijulio [3.50])

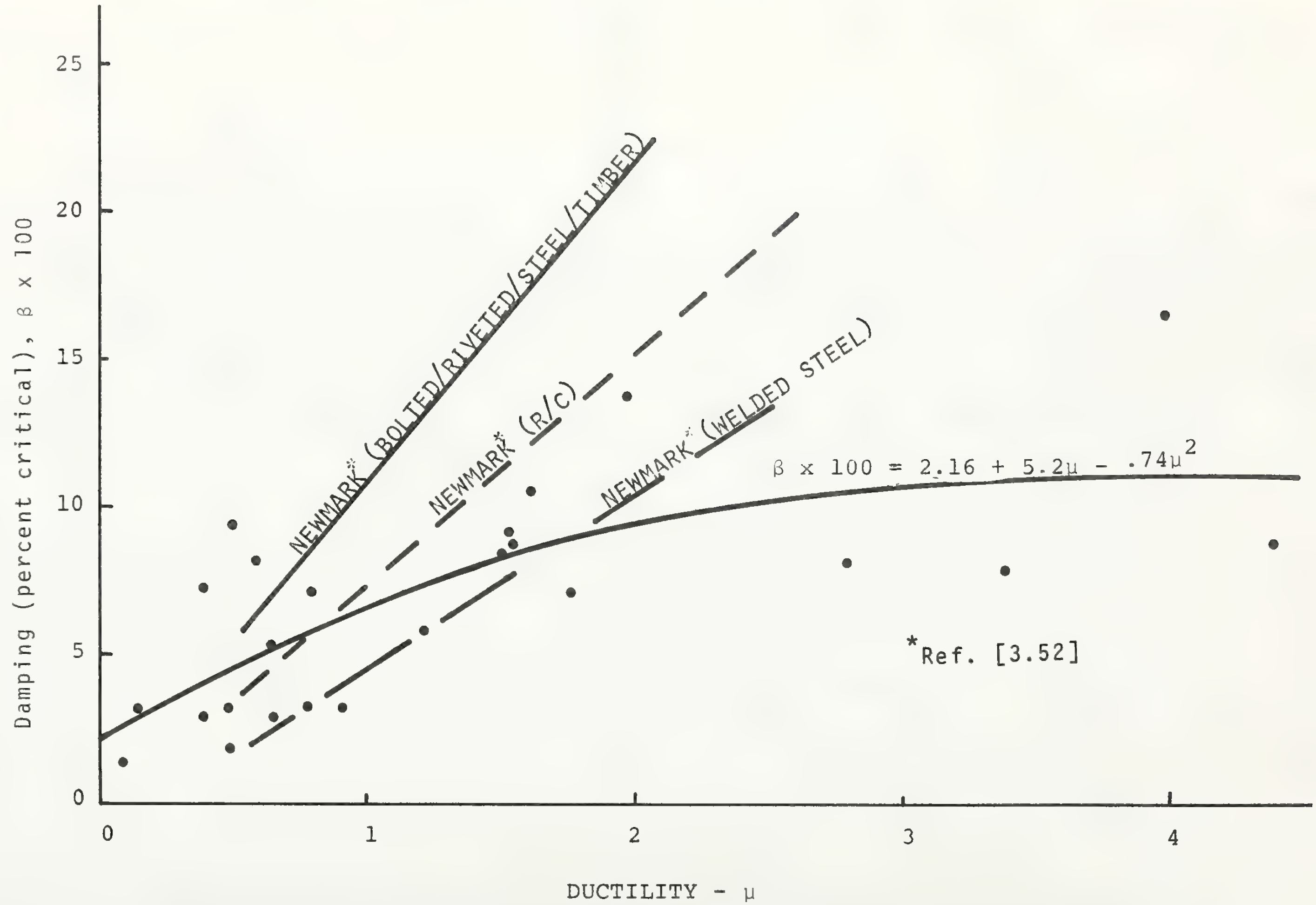


Figure 3.43 Variation of Damping as a Function of Ductility

The curve's equation based upon the San Fernando earthquake data is

$$(\beta \times 100) = \text{percent damping for concrete or steel buildings} = 2.16 + 5.2\mu - 0.74\mu^2 \quad (3.4.48)$$

For timber, bolted and riveted steel buildings, this formula, multiplied by a factor of two, is recommended and programmed for estimating damping. This gross relationship is based on experience [3.52].

Response to Earthquake Loading - Amplitude Dependence of Period

The computer program which preforms a detailed analytical damage analysis allows the user the option of directly including a variation in the magnitude of building period with ductility level. A computer algorithm is included which relates the variation in period with ductility level for an elasto-plastic response model. Appendix C of [3.11] presents the original work of W. T. Thomson in this area and figure 3.44 summarizes his findings. The computer algorithm utilizes the equation noted in this figure.

Response to Wind, Tornado and Hurricane Loading

As discussed in section 3.40 the wind loads acting on a building are a function of the building's fundamental natural period of vibration and damping. The latter quantity must be input by the user to the computer program whereas the former is evaluated using any one of the three characterizations detailed in section 3.4E. The user is advised to estimate the building damping using his professional experience and, because of the lack of damping estimates during strong winds, to use damping values from seismic response studies. The forces acting on the building, while static in character, are a function of the dynamic parameters of the building. Both tornado and hurricane loads are based upon wind loads resulting from a prescribed wind velocity and therefore the response procedure for these types of natural disasters does not differ from that used for strong winds.

A force vector $\{F\}$ is computed from a net pressure distribution along the building by multiplying the pressure at each story, P_i, by the tributary story area A_i. Thus, the wind pressure force F_i acting at the ith story is

$$F_i = P_i A_i \quad (3.4.49)$$

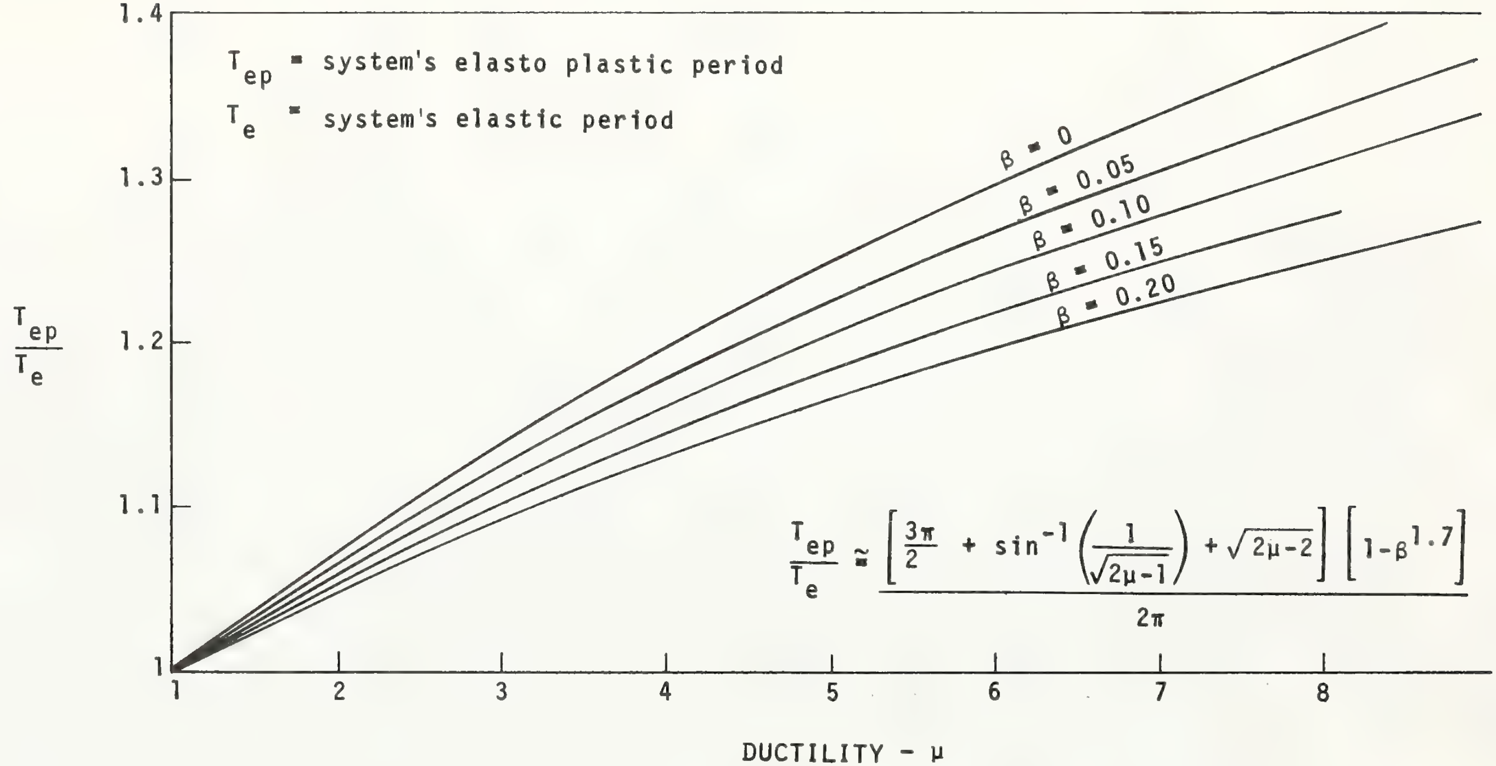


Figure 3.44 Ratio of Elastoplastic to Elastic Periods [3.11]

A displacement vector {z} is computed from the matrix equation

$$\{z\} = [K]^{-1} \{F\} \tag{3.4.50}$$

where [K] is the building's stiffness matrix. The interstory drift due to wind loading is given by the vector $\{\Delta\}$ where

$$\Delta_i = \begin{cases} z_{i+1} - z_i & : i < n \\ z_i & : i = n \end{cases} \tag{3.4.51}$$

If the detailed or story stiffness characterization option is chosen, see section 3.4E, then the building stiffness matrix is calculated directly. However, if the empirical modeling option is chosen then only the building's fundamental period of vibration and mass are available. In this latter case the building response is calculated using a simplified analysis. Considering the building to be a uniform cantilever beam its fundamental period of vibration can be expressed in terms of the roof deflection if the beam is assumed to be acted upon by a uniformly distributed loading, i.e.,

$$T_n = \text{fundamental period of cantilever beam} = \frac{2\pi l^2}{3.52}\sqrt{\frac{w}{EIg}}$$

and

δ = deflection at the end of a uniform fixed-end cantilever beam subjected to a static uniform load equal to the total beam weight divided by the beam length (i.e., building weight/ building height)

$= wl^4/8EI$

therefore

$$\delta = (3.89\ T_n)^2 \text{ inches} \tag{3.4.52}$$

Since the total wind force acting on the building is known from the load generation part of the program the total deflection at the top of the building is calculated to be

$$Z_1 = \text{deflection at top of building}$$

$$= \left[\frac{(\text{Total Wind Force on Building})}{(\text{Total Weight of Building})}\right] \delta \tag{3.4.53}$$

A straight line deformation shape is assumed to obtain interstory displacements. This approach is very simple and involves assumptions which can be eliminated if the user goes to the extra effort of using a story stiffness model.

G. Earthquake Damage Evaluation Methodology

This section presents the methodology which is used to evaluate the damageability of a building due to earthquake excitation. Two Damage categories are considered - structural and nonstructural. Structural damage is based upon the calculated level of interstory drift. Nonstructural partition damage is based upon the level of floor velocity and acceleration via an Effective Floor Modified Mercalli Intensity and window damage is dependent upon interstory drift. All types of damage are estimated on a floor-by-floor basis.

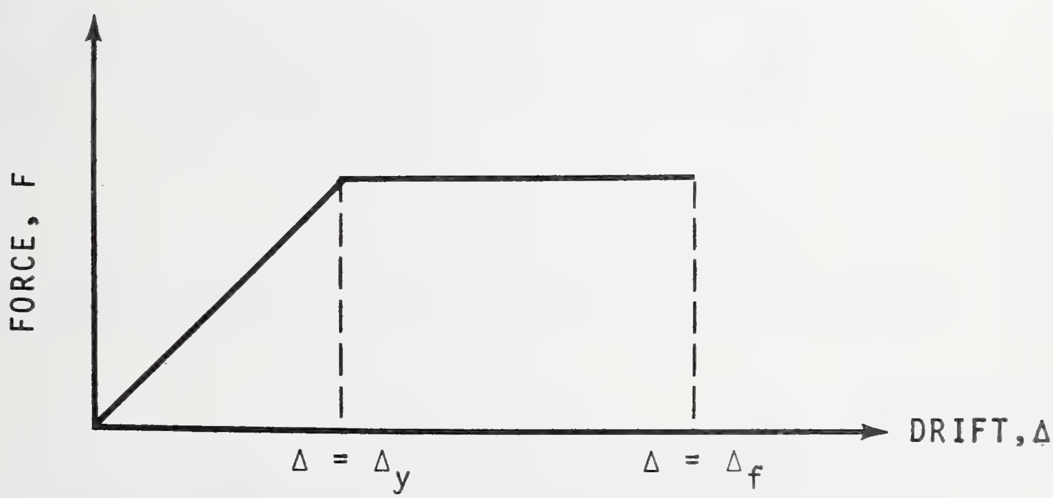
Prior to proceeding with the details of the earthquake damage algorithm, a general discussion of the philosophy behind the approach seems appropriate.

Any engineer who has performed laboratory tests realizes that the response level at which a test specimen fails is a random variable. Stated differently, the value of the response level at failure is not the same for all test specimens. The scatter in the values of the failure response levels usually has a central tendency, and engineering experience indicates that the scatter in failure values tends to be distributed about this mean in a bell-shaped form.

The following hypothetical example is used to clarify the point. A frame (see figure 3.45) is acted upon by a force, denoted F. As the magnitude of the force is increased, the frame deflects laterally and its value, denoted Δ, increases. At a drift of $\Delta = \Delta_y$ the frame reaches its yield point, and at the greater drift value of $\Delta = \Delta_f$, the frame reaches failure. Now, imagine that this experiment is repeated many times (say, 100 for this hypothetical example) and the magnitude of the failure drift is recorded for each experiment. If these 100 failure data points are plotted against Δ_f and a smooth curve drawn through them one would expect them to follow a bell-shaped curve as indicated in figure 3.46(A). Figure 3.46(B) shows the same data presented in an alternate from where the area under the curve in figure 3.46 (A) to the left of Δ_f represents the cumulative percentage of failures of levels up to and including Δ_f. The vertical axis of the plot in figure 3.46(A) is labeled the "Probability Density of Failure" and the vertical axis of the corresponding S-shaped curve in figure 3.46(B) is labeled "Percentage of Specimens failing at drift $\leq\Delta_f$." Mathematical expressions can be written for both of these curves. It follows that if one defines

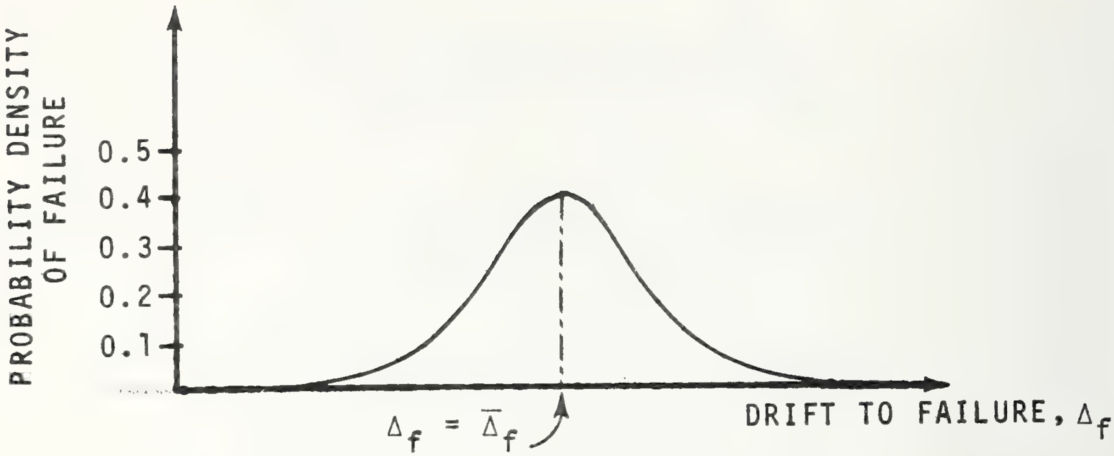
$$X \equiv \Delta_f \text{ and } \overline{X} \equiv \overline{\Delta}_f$$

(A) SIMPLE FRAME

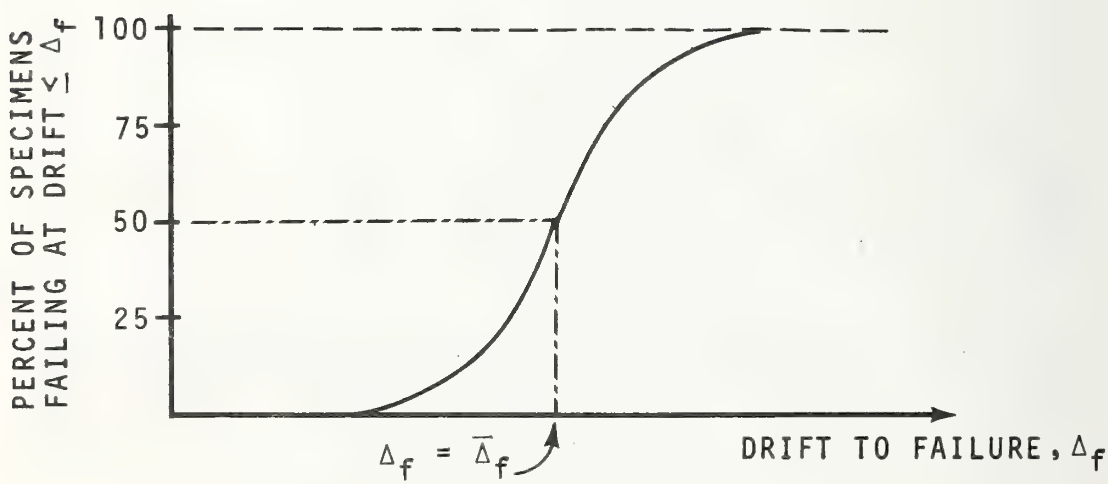


(B) FORCE - DRIFT CURVE

Figure 3.45 Description of Hypothetical Example



(A) BELL-SHAPED FAILURE CURVE



(B) S-SHAPED FAILURE CURVE

Figure 3.46 Failure Curves

then for the Bell-shaped curve in figure 3.46(A), one has

$$f(X) = \frac{1}{\sqrt{2\pi}\ \sigma} \exp\left\{ - \frac{1}{2} \left[\frac{X - \bar{X}}{\sigma} \right]^2 \right\} \tag{3.4.54}$$

and corresponding to the S-shaped curve in figure 3.46(B), one has

$$F(X) \approx \frac{100}{\sqrt{2\pi}\ \sigma} \int_0^X \exp\left\{ - \frac{1}{2} \left[\frac{Z - \bar{X}}{\sigma} \right]^2 \right\} dZ \tag{3.4.55}$$

It is apparent from an inspection of equations (3.4.54) and (3.4.55) that

$$F(X) \approx 100 \int_0^X f(Z)dZ \tag{3.4.56}$$

The curves defined by equations (3.4.54) and (3.4.55) are the well-known Normal Density and Distribution curves. In the above equations the two constants $\bar{X}$ and σ are given the special names of:

σ = standard deviation of failure
$\bar{X}$ = mean failure

The mean is the central tendency parameter and the standard deviation is the dispersion parameter. Large values of standard deviation mean a flatter bell-shaped curve. An important parameter which is often used in place of the standard deviation because of its nondimensionality is

$$C_v = \frac{\sigma}{\bar{X}} = \text{coefficient of variation} \tag{3.4.57}$$

The significance of the numerical value of the coefficient of variation is evident from a study of F(X) at different values of N where

$$X = \bar{X}\ (1 + NC_v) \tag{3.4.58}$$

In particular, table 3.17 shows the value of F(X) corresponding to various values of N. Therefore, it is apparent that as C_v increases, the product of NC_v increases without an increase in N.

TABLE 3.17 FAILURE PERCENTAGE VERSUS RESPONSE LEVEL

$\left(\frac{X - \bar{X}}{\sigma}\right)$	Percentage of Specimens Which Have Failed F(X)	Percentage of Specimens Which Have Not Failed 1-F(X)
0.0	50.0	50.0
0.5	69.2	30.8
1.0	84.1	15.9
1.5	93.3	0.7
2.0	97.7	2.3
2.5	99.4	0.6
3.0	99.9	0.1

The preceding discussion outlines the classic introduction of the cumulative probability distribution curve. However, a somewhat different point of view is adopted herein for its application to damage estimation. For a particular building, one is not interested in the distribution of failure characteristics with respect to a field of 100 identical buildings. The concern, rather, is with the percentage of structural elements or components which fail in a single building as a function of its response level. In general, many structural members comprise the primary or secondary structure of one story of a building. As the building responds to earthquake induced ground motion, the structural elements in that particular story are strained to varying degrees for a single value of interstory drift, Δ. As interstory drift increases, the strain in each member increases and corresponding to three levels of drift, say $\Delta_1 < \Delta_2 < \Delta_3$, one may find that 1%, 5% or 30% of the structural members at that story are strained to their ultimate capacity and therefore fail. Equation (3.4.55) is used to characterize this percentage of structural members failing at a particular floor level for a specified amplitude of interstory drift. In particular, if the interstory drift is equal to $X = X_o$ and C_v and X have been defined then the percentage of structural components or members which will fail is $F(X = X_o)$, i.e.,

$$F(X = X_o) = \frac{100}{\sqrt{2\pi}\,\bar{X}C_v} \int_0^{X=X_o} \exp\left\{ -\frac{1}{2}\left[\frac{Z-\bar{X}}{\bar{X}C_v}\right]^2 \right\} dZ \quad . \; . \; . \; . \; . \quad (3.4.59)$$

Structural Damage

The extent of structural damage experienced by a building during an earthquake is expressed on a floor-by-floor basis. For each floor of the building a percentage of damage between 0 and 100 is calculated which reflects the percent of structural members which fail for that floor (0 percent is no damage and 100 percent is complete damage). This damage is dependent upon (1) calculated interstory drift, denoted Δ; (2) interstory drift to yield, denoted Δ_y; (3) ductility of component which can be expected prior to failure, μ_f; (4) duration of motion at significant response levels. Also inherent in the selection of a component's drift to yield and ductility to failure is its quality. This subjective factor will be discussed later, however, for the present discussion it is sufficient to note that the quality of the structure is dependent upon its construction materials, supervision during construction, etc. Insight into the selection of numerical values for Δ_y and μ_f is discussed later.

The response parameter used to indicate the extent of structural damage is story ductility. Story ductility, μ_i, is calculated using the equation

$$\mu_i = \frac{\Delta_i}{(\Delta_y)_i} \tag{3.4.60}$$

where

Δ_i = calculated interstory drift of ith story

$(\Delta_y)_i$ = user specified interstory drift to yield of ith story

The interstory drift Δ_i is calculated in the structural response module of the computer program and the interstory drift to yield (Δ_y) is input by the user. Attention is now turned to response capacity.

The ductility which a structural component can experience prior to failure in a single load to failure test is denoted μ_f. This ductility value corresponds to a monotonic loading to failure. To reconcile the difference between a laboratory monotonic test value and a ductility to failure that an in-place building member can experience prior to failure, Wiggins and Moran have proposed the following formula based upon a regression analysis of elasto-plastic response (see [3.11], Appendix K).

$(\mu_c)_i$ = ductility to failure during an earthquake of Richter magnitude M for a building with fundamental period T_1.

$$= \left[\frac{T_1}{.0046\, e^M}\right] (\mu_f)_i; \quad 1 \leq (\mu_c)_i \leq (\mu_f)_i \tag{3.4.61}$$

The concept of this factor (μ_c) is an important one and studies should be made to see if the above relationship is appropriate for a wide range of force-deflection relationships. To better understand this factor consider figure 3.47. Because of the cyclic nature of dynamic structural response the structural component can reach its failure ductility level with one single large cycle of motion, or alternately from the cumulative yielding effect of several cycles of response. This cumulative effect results from the properties of the structural components. A pictorial representation of this characteristic is shown in figure 3.47. In the earthquake problem the transient character of the response (usually less than one minute of strong motion) can allow the structure to undergo yielding and yet it is possible that the component may never reach the failure drift level.

The building period and Richter magnitude which are to be used in this equation have been specified or calculated as part of the Earthquake Loading Module. This formula reduces the ductility to failure based upon the number of cycles of fundamental mode response experienced by the building components during the strong motion phase of the earthquake.

It is recognized that the value of ductility to failure will vary among the various structural members comprising any given story. To account for this dispersion a parameter, denoted C_v, is defined and associated with $(\mu_c)_i$. This parameter may be interpreted as a coefficient of variation when damageability is interpreted probabilistically.

Once this coefficient is specified and assuming that the ductility to failure is a normally distributed curve (i.e., S-shaped) then the percent structural damage associated with the ductility at any floor level is uniquely determined, see figure 3.48. The equation for the percent structural damage at the ith floor is

$$\begin{bmatrix}\text{Percent Damage}\\ \text{(ith floor)}\end{bmatrix} = \frac{100}{\sqrt{2\pi}(\mu_c)_i(C_v)_i} \int_o^{\mu_i} \exp\left\{-\frac{1}{2}\left[\frac{Z-(\mu_c)_i}{(\mu_c)_i(C_v)_i}\right]^2\right\} dZ \quad ..(3.4.62)$$

where

$(C_v)_i$ = coefficient of variation of $(\mu_c)_i$ for the ith floor

μ_i = calculated ductility of the ith floor

<u>Nonstructural Damage</u>

The estimation of nonstructural damage in a building during an earthquake is a very difficult problem. Historical damage data have not differentiated between the financial loss associated with structural and nonstructural damage (see Appendix H of [3.11]). However, it is apparent that there exists a correlation between nonstructural damage and such factors as (1) level of absolute floor acceleration, (2) level of interstory displacement and (3) the quality of the building.

The approach taken herein to estimate nonstructural damage is based upon past research in single family dwelling damage estimation and professional engineering judgment.

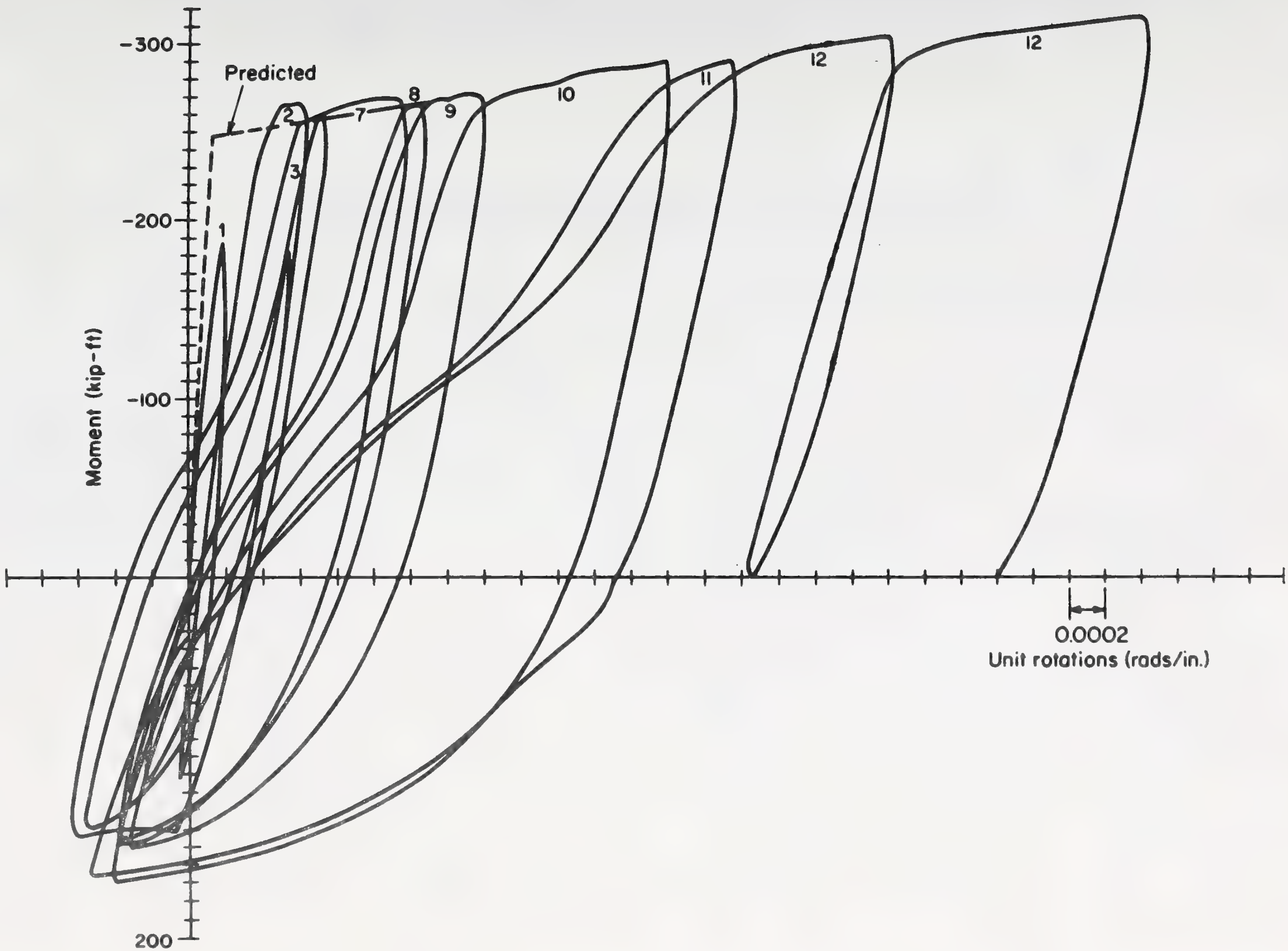
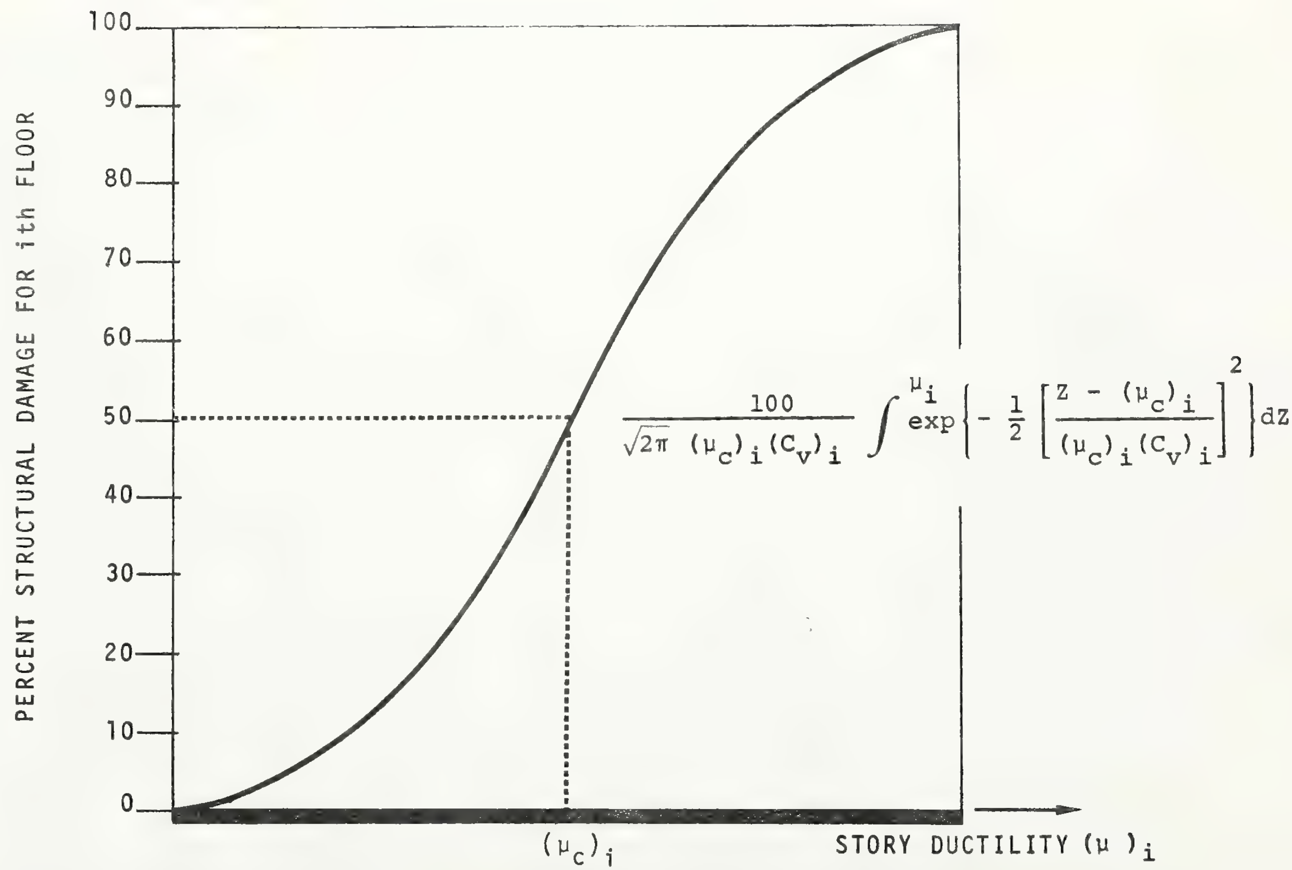


Figure 3.47 Typical Load Deflection Pattern For Structural Member



$$\frac{100}{\sqrt{2\pi}\,(\mu_c)_i(C_v)_i}\int^{\mu_i}\exp\left\{-\frac{1}{2}\left[\frac{Z-(\mu_c)_i}{(\mu_c)_i(C_v)_i}\right]^2\right\}dZ$$

Figure 3.48 Structural Damage Versus Ductility

First, a general correlation exists between site Modified Mercalli Intensity and nonstructural damage (see table 2.1). Second, empirical relationships exist between Modified Mercalli Intensity and maximum site acceleration and velocity, see equations (3.4.20) and (3.4.21). Therefore, the presented nonstructural damage estimation procedure considers each floor of the building to be a potential damage site. The building response calculations produce for each floor the maximum acceleration and velocity and therefore these are used in

$$I_i = 3.50 \log_{10}(A_i) + 10.28 \qquad (3.4.63a)$$

$$I_i = 2.73 \log_{10}(V_i) + 5.16 \qquad (3.4.63b)$$

where

V_i = maximum velocity of ith floor (in/sec)

A_i = maximum acceleration of ith floor (g's)

to estimate the <u>Effective Floor Modified Mercalli Intensity</u>, I_i. Since two intensities are possible, the computer program takes the maximum intensity from equation (3.4.63) and estimates the percent non-structural loss for each floor using the equation

$$\begin{bmatrix}\text{Percent Damage} \\ \text{(ith floor)}\end{bmatrix} = 10^{\left[-4.62 + 0.552\, I_i \left(1 - \frac{Q_i - 3}{6}\right)\right]} \qquad (3.4.64)$$

where

I_i = Effective Modified Mercalli Intensity of ith floor

Q_i = Quality Factor for the ith floor (to be discussed in later paragraphs).

Equation (3.4.64) is an empirical equation and is an extension of an earlier formula [1.1] where the inclusion of the building quality factor into the equation represents the extension. The empirical constants in (3.4.64) were obtained from a regression analysis of the data presented in [3.57 - 3.59].

The nonstructural damage associated with window breakage is calculated in a separate computer module. Glass damage results from distortion in the window frame of the type shown in figure 3.49.

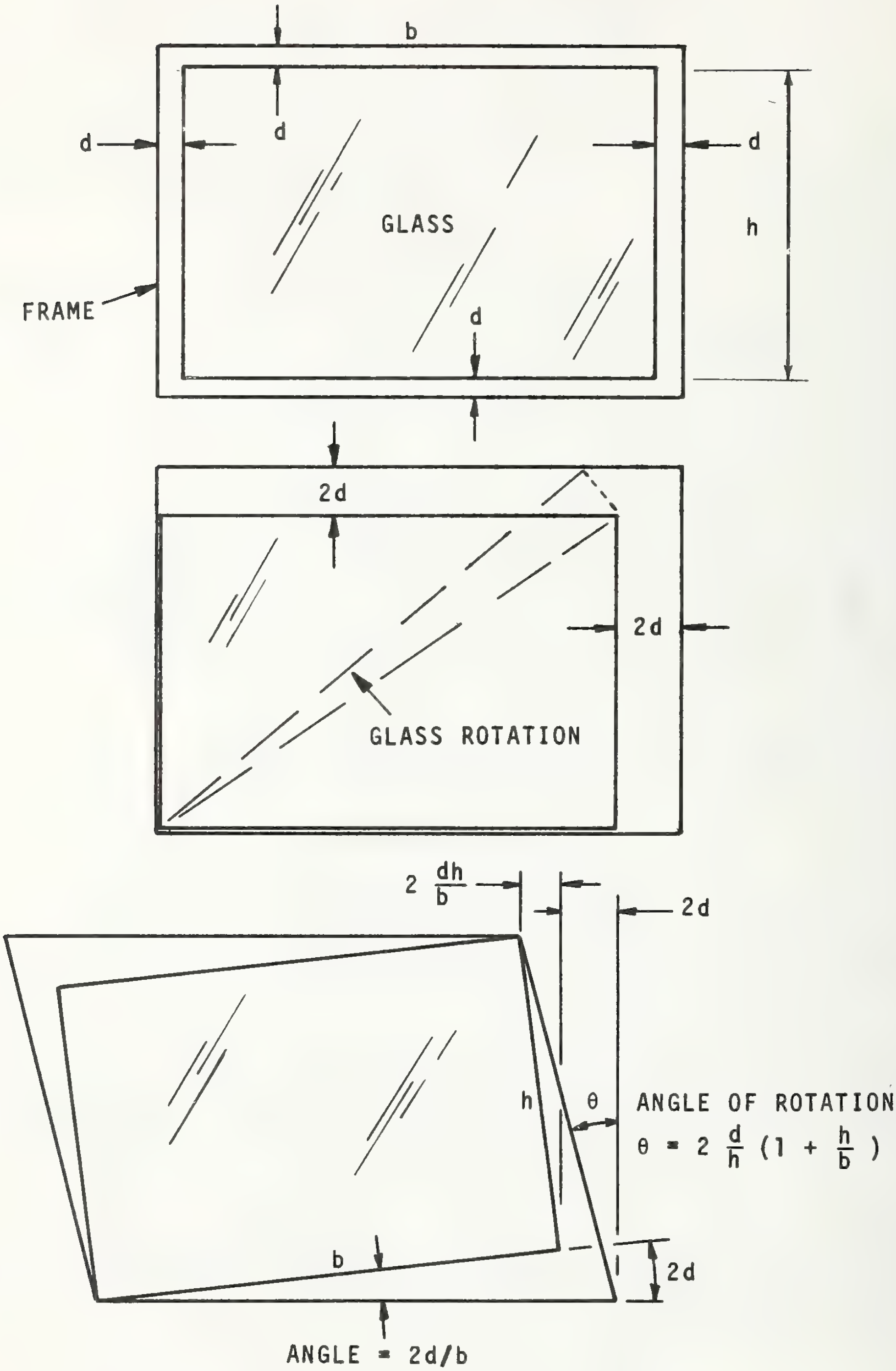


Figure 3.49 Glass Rotation Conditions

The selected algorithm for window damage is based on an uncertainty model concerning the binding or degree of fixity of a window as it cracks during an earthquake. An assumption is that the glass breaks when it reaches the drift value

$$(\Delta_G)_i = \frac{2d_i}{h_i}\left(1 + \frac{h_i}{b_i}\right) \qquad (3.4.65)$$

where:

d_i = mean clearance of mullions on the ith floor windows

h_i = mean height of windows on the ith floor

b_i = mean width of windows on the ith floor

$(\Delta_G)_i$ = drift to failure of window glass on the ith floor

Uncertainty in the mean mullion clearance, d_i, produces uncertainty in the window drift to failure, $(\Delta_G)_i$. Therefore, it is readily apparent that associated with a calculated interstory drift for the ith floor, Δ_i, one can obtain a percentage of windows broken which depends, in addition to the above parameters, upon the coefficient of scatter of the drift to failure of the glass, $(C_{VG})_i$. The percent of windows broken at the ith floor may be expressed as.

$$\left(\begin{array}{c}\text{Percent of Windows}\\ \text{with broken glass}\\ \text{on ith floor}\end{array}\right) = \frac{100}{\sqrt{2\pi}\,(\Delta_G)_i(C_{VG})_i}\int_0^{\Delta_i} \exp\left\{-\frac{1}{2}\left[\frac{Z-(\Delta_G)_i}{(\Delta_G)_i(C_{VG})_i}\right]^2\right\}dZ$$

(3.4.66)

Building Quality Factors

The previous section introduced the concept of a building quality factor, and it was noted that the level of both structural and nonstructural damage depends upon this factor. Therefore, to give the computer program user some guidance in evaluating the quality of a building and its parts, qualified professional engineers in the field of structural damage investigations present herein their judged opinions of "Quality" regarding structural and nonstructural elements. These engineers, Donald F. Moran and Roy G. Johnston have prepared table 3.18 for the structural materials most commonly encountered in practice. Donald F. Moran prepared quality rating table 3.19 for nonstructural categories.

TABLE 3.18 QUALITY RATING OF MATERIALS IN STRUCTURAL SYSTEM (a. Strength)

Material	Quality		
	Good Q = 3	Average Q = 2	Poor Q = 1
Structural Steel & Metal Decking	$f_y \geqq 40$ ksi Double sheet metal decking	$f_y \geqq 30$ ksi Single sheet metal decking	$f_y < 30$ ksi Cast iron Corrugated Iron
Concrete: Including Precast & Prestressed	$f'_c \geqq 3$ ksi	$f'_c \geqq 2$ ksi	$f'_c < 2$ ksi
Masonry (Based on core tests or specified strengths)	$f'_m \geqq 2.0$ ksi Mortar $f'_c \geqq 2.0$ ksi Grout $f'_c \geqq 2.0$ ksi Continuous Inspection	$f'_m \geqq 1.2$ ksi Mortar $f'_c \geqq 1.0$ ksi Grout $f'_c \geqq 1.0$ ksi Called Inspection	$f'_m < 1.2$ ksi Mortar $f'_c < 1.0$ ksi Old sand-lime mortar Grout $f'_c < 1.0$ ksi No Inspection
Timber Plywood	$f_b \geqq 1.9$ ksi Select Structural Structural I Plywood	$f_b \geqq 1.5$ ksi Construction Industrial Structural II Plywood	$f_b < 1.5$ ksi Not Grade Marked Plywood not grade marked
Gypsum	$f'_g \geqq 1.0$ ksi	$f'_g \geqq 0.5$ ksi	$f'_g < 0.5$ ksi

TABLE 3.18 QUALITY RATING OF MATERIALS IN STRUCTURAL SYSTEM (b. Physical Condition)

Material	Physical Condition		
	Good Q = 3	Average Q = 2	Poor Q = 1
Structural Steel and Metal Decking	No weld cracks. No cracks at holes. No corrosion.	Few cracked welds (none critical). Few cracks at holes (none critical). Slight corrosion. Machine bolts.	Many cracked welds. Many cracks at holes. Moderate corrosion.
Concrete: Including Precast & Prestressed	Few minor shrinkage cracks. No shear or flexure cracks. No excessive deflection, (i.e., drift $\leq$ story height divided by 240).	Few shear and/or flexure cracks (none critical). Few shrinkage cracks. Few cracked welds at precast connections.	Many shrinkage cracks. Many shear and flexure cracks. Deteriorated concrete. Exposed reinforcing. Excessive deflections in beams and slabs. Many cracked welds.
Masonry	Few minor shrinkage cracks. No shear or flexure cracks. Plumb walls.	Few moderate shrinkage cracks. Few shear or flexure cracks.	Many shrinkage cracks. Many shear and flexure cracks. Deteriorated, soft mortar. Exposed reinforcing. Bowed and out of plumb walls.
Timber and Plywood	No splits or twisted members. No loose bolts or screws. No loose knots. No projecting nails on bottom side. Grade worked lumber.	Few knots and splits, twisted members. Few loose bolts & screws. Minor-moderate deflections. Few loose nails. Fair nailing pattern. Fair connections.	Many splits and twisted members. Many loose bolts & screws. Rotting. Excessive deflections. Many loose nails.
Gypsum	No cracks in formboard. Good connection details. Smooth hand surface.	Few cracks in formboard. Crack pattern over T-supports.	Many cracks and excessive deflection of formboard.

TABLE 3.18 QUALITY RATING OF MATERIALS IN STRUCTURAL SYSTEM (c. Integrity)

Material	Workmanship		
	Good Q = 3	Average (Note A) Q = 2	Poor (Note A) Q = 1
Structural Steel	All parts of joints in full contact. Members straight. Structure plumb. Bolts tight. Structural welds all OK. Deck welds all OK. Continuous Inspection.	Few joints with members not in full contact. Few bent members. Few loose bolts. Few poor welds. Selective Inspection.	Many joints with members not in full contact. Many bent members. Many loose bolts. Many poor welds. No Inspection.
Concrete (Including Precast and Prestressed)	Clean construction joints. No rock pockets. Construction straight and plumb. All tendons grouted. Continuous inspection.	Few poor construction joints. Few small rock pockets. Few members show evidence of form failure. Few poor welds at precast joints. Tendons not grouted. Called inspection.	Many poor construction joints. Many rock pockets. Many evidences of form failure. Mixture of hardrock and lightweight concrete at joints. Many poor welds. No inspection.
Masonry	All grout and mortar spaces filled. Construction straight and plumb. Running bond. Continuous inspection.	Few grout and mortar spaces not filled. Running bond. Called inspection.	Many grout and mortar spaces not filled. Construction bowed and out of plumb. Stacked bond. No inspection.
Timber and Plywood	All members in full bearing contact at joints. Bolts & screws tight. Members straight & plumb. All plywood edges blocked with members 3"+ in width. Continuous inspection.	Few members not in full contact. Few loose bolts & screws. Few twisted or bowed members. Diagonal sheathing well nailed. Blocking by cleats and members 2"+ in width. Called inspection.	Many members not in full contact. Many loose bolts & screws. Many twisted and/or bowed members. Straight sheathing. Unblocked plywood. Irregular nail spacing & edge distance. No inspection.
Gypsum	Smooth hard surface. Continuous inspection.	Fair surface. Called inspection.	Rough, uneven surface. Soft material. No inspection.

TABLE 3.18 QUALITY RATING OF MATERIALS IN STRUCTURAL SYSTEM (d. Workmanship)

Material	Quality: Good Q = 3	Quality: Average Q = 2	Quality: Poor Q = 1
Structural Steel and Metal Decking	Ductile framing details. High strength bolts or good weld details to member. Approved tested deck systems properly welded and connected. Members well braced laterally. Decking welded for ≥ 1.0 K/LF in. shear.	Main connections are riveted or welded. Minor connections with unfinished bolts. Some members not adequately braced laterally. Decking welded for ≥ 0.5 K/LF in. shear.	Machine bolted connections. No lateral bracing of members. Deck diaphragm. <0.5 K/LF
Concrete: a. Poured in place b. Precast c. Pre-stressed	Close spacing of ties and stirrups. Ductile reinforced details. Spiral type columns. No precast or prestressed members.	Ordinary reinforced details tied columns. (#3 and over). Poured precast joinery well detailed w/welded reinforced precast & prestressed members.	Deficient framing details. No mild steel Deficient reinforced details tied columns (#2 & smaller). Welded precast joinery.
Masonry	Fully grouted members. Embedded anchors, bolts, & strap ties. Adequate reinforced, uniformly spaced in two directions. All columns filled. Adequate laps at corners and intersections. Adequate bars at openings.	Bolted connections. Adequate reinforced, concentrated at tops & bottoms of walls. Columns filled at reinforcing only. Horizontal mesh reinforced.	Non-grouted wall, nailed connection. No or partial reinforcement. Poor tie and lap details. Filler walls not anchored to framing.
Timber	Strap anchors to masonry walls plus shear transfer connections.	Melar hardware at some connections. Few steel strap ties at joints.	No connections to masonry walls. No strap at connections.
Plywood	Bolts at critical joints well anchored to footings. Steel strap ties to walls spaced 4 ft. or less.	Bolted & nailed joints anchored to footings. No strap ties or straps over 4 ft. o.c.	Not anchored to footings. No strap ties.
Gypsum	Trussed purlins. Adequate connection to walls. Mesh reinforced.	Solid purlins. Poor connections to walls.	No reinforcement. No connections to walls.

TABLE 3.19 QUALITY RATINGS FOR NONSTRUCTURAL COMPONENTS

Component	Quality		
	Good Q = 3	Average Q = 2	Poor Q = 1
Ceilings	Gypsum Board and MLP attached directly to structural framing (not suspended)	Suspended wood framing with Gypsum Board nailed Suspended Metal Lath and Plaster. Suspended Plywood nailed to wood framing.	Suspended "T" Bar with lay-in or splined acoustical tiles.
Partitions	Wood Panel, well anchored and braced to structure	Gypsum Board and Metal Studs and Plaster, anchored and braced to structure	Unreinforced masonry and Gypsum block. Ceiling height partitions, braced by suspended "T" bar ceilings.
Trim and Veneer	Not Applicable	Masonry Veneer and facings, well anchored and with cement mortar	Masonry Veneer on facings, not anchored and with poor mortar. Heavy ornamentation such as statues, steeples, and cornices.
Glass	Full elastomeric mounting with at least 1/2" clearance all around. Glass set outside of framing.	Elastomeric Mounting, 1/4" Clearance, set between framing.	Fixed sash with putty - negligible clearance
Filler Walls Between Framing Members	Reinforced Concrete or masonry wall anchored to frame. Metal and wood studs and plaster anchored to structure.	Unreinforced masonry cement mortar anchored to structural framing.	Unreinforced masonry, poor mortar. No anchorage to structural framing.

TABLE 3.19 QUALITY RATINGS FOR NON-STRUCTURAL COMPONENTS
(Continued)

Component	Quality		
	Good Q = 3	Average Q = 2	Poor Q = 1
Curtain walls set outside of framing line	Reinforced concrete and masonry well anchored to structure. Metal frame and siding well anchored. Struss well anchored.	Unreinforced masonry with good cement mortar. Anchored to structure. Precast concrete units - well anchored to structure.	Unreinforced masonry, poor mortar, not anchored to structure. Precast concrete units, welded anchorage.
Fire Escapes	Not Applicable.	Metal Framing attached to building.	Free standing concrete and masonry.
Overhangs and Gargoyles	Not Applicable.	Reinforced and anchored.	Unreinforced masonry, poorly anchored.
Signs and Marquees	Not Applicable.	Steel Frames. Signs on roof and walls.	Heavy marquees.
Antennae	Steel Towers Guyed.	Steel towers on roof not guyed.	Not Applicable.

The damage evaluation program uses the quality of the structure in two separate ways. First, as direct input to the computer program the user must specify the quality of each floor of the building. This quality factor only relates to nonstructural components and the values input are used in equation (3.4.64). Table 3.19 is presented so as to assist the user in the selection of nonstructural quality factors (note, one quality factor is input per floor). Since it is possible that different quality ratings may exist for each of the component types noted in tables 3.18 and 3.19 the user must average the ratings and obtain one rating value for each floor. The final floor rating need not be an integer. The second way in which building quality is utilized is indirectly through the selection of the drift to yield and the ductility to failure of the building's structural components. Table 3.18 is presented to assist in the establishment of the quality level of the structural system components. Later in this section it is shown how this latter quality is used to estimate drift to yield and ductility to failure. Therefore, in summary the quality factor for structural components is used to estimate drift to yield and ductility to failure.

Estimating Drift to Yield and Ductility to Failure

The estimation of structural damage using the methodology presented herein requires the user to input on a floor-by-floor basis his estimates of drift to yield, Δ_y, and ductility to failure, μ_f, for structural framing, shearwall members and floor diaphragms. To assist in this respect three professional engineers have presented their estimates of these values for various structural elements and quality factors. Tables 3.20 and 3.21 contain these estimates. It is apparent that the scatter among estimates by qualified professional engineers can be considerable. However, it is expected that the scatter would not be as great if attention were focused on one actual building.

If the engineer does not wish to use the guidelines presented in tables 3.20 and 3.21 he may (1) set values for the parameters based on his own professional judgment, or (2) attempt to find test results which provide parameter estimates for his particular problem, see [3.11]. To assist the engineer who wishes to utilize his own professional judgment the following comments are appropriate.

TABLE 3.20 JUDGED VALUES OF DRIFT TO YIELD (IN/IN) FOR VARIOUS QUALITY RATINGS

Function	Material	Δ_y - Drift to Yield											
		Good Q=3				Average Q=2				Poor Q=1			
		MO	JO	JA	Mean	MO	JO	JA	Mean	MO	JO	JA	Mean
Frame Member	Structural Steel	.010	.015	.013	.013	.005	.010	.009	.008	.002	.006	.004	.004
	Concrete: Poured in Place	.005	.010	.012	.009	.003	.006	.008	.006	.002	.003	.004	.003
	Precast Prestressed	.010	.004	.003	.006	.005	.002	.002	.003	.002	.001	.001	.001
	Timber	.020	.020	.005	.015	.010	.015	.003	.009	.005	.007	.002	.005
Shearwall	Concrete: Poured in Place	.002	-	.010	.006	.001	-	.007	.003	.001	-	.003	.002
	Precast Prestressed	.002	.004	.003	.003	.001	.002	.002	.002	.001	.001	.001	.001
	Masonry	.003	.007	.010	.007	.002	.005	.007	.005	.001	.003	.003	.002
Diaphragm	Metal Decking	.010	.010	.007	.009	.005	.007	.004	.005	.002	.004	.002	.003
	Plywood	.010	.010	.008	.009	.005	.007	.006	.006	.002	.005	.003	.003
	Gypsum	NA	.004	.003	.004	NA	.002	.002	.002	NA	.001	.001	.001

MO - Donald Moran JO - Roy Johnston JA - Jack Janney NA - Not Applicable

TABLE 3.21 JUDGED VALUES OF DUCTILITY FOR VARIOUS QUALITY RATINGS

Function	Material	μ_f - Ductility to Failure											
		Good Q=3				Average Q=2				Poor Q=1			
		MO	JO	JA	Mean	MO	JO	JA	Mean	MO	JO	JA	Mean
Frame Member	Structural Steel	20	16	17	18	10	8	11	10	5	2	5	4
	Concrete: Poured in Place	10	8	13	10	5	4	9	6	2	2	4	3
	Precast Prestressed	NA	2	13	8	3	2	9	5	2	2	4	3
	Timber	10	8	14	11	5	4	9	6	3	2	5	3
Shearwall	Concrete: Poured in Place	5	4	11	7	3	3	7	4	1	2	4	2
	Precast Prestressed	NA	2	5	4	2	2	3	2	1	2	2	2
	Masonry	5	6	11	7	3	4	7	5	1	2	4	2
Diaphragm	Metal Decking	15	8	11	11	8	6	7	7	3	2	4	3
	Plywood	10	6	14	10	5	4	9	6	3	2	5	3
	Gypsum	5	4	8	6	3	3	5	4	2	2	3	2

MO - Donald Moran JO - Roy Johnston JA - Jack Janney NA - Not Applicable

The load deflection characteristics of simple steel and/or concrete elements is reasonably well understood. For example, figure 3.50 shows a typical load deflection curve for structural beams and beam-columns. In each case the shape of the curve is basically the same. The question to be answered is what values of drift to yield and ductility to failure can be inferred from data of this type and observed building response during earthquakes? Two alternate approaches to answering this question appear to be appropriate. Prior to discussing these approaches, it is to be noted that since there have never been <u>any</u> detailed measurements of interstory drift for buildings subjected to severe earthquakes, no method can be stated as best.

One approach to specifying drift to yield during earthquake response is to relate the drift to SEAOC recommended design drift levels [3.6]. In particular, the recommended design drift limitation is 0.005. The basic notion now is to use one's professional experience to specify what multiple of this 0.005 value corresponds to a drift at which story yielding occurs. One may use a multiplication factor of unity but any design engineer knows that many factors of safety exist and the factor should be greater than unity. A complete study of the San Fernando building response data is not yet complete. However, it was observed that building response exceeded code design base shears by up to two without any observable damage. One could infer from this that it is possible to exceed the 0.005 drift by approximately a multiple of two and not experience damage. In fact, the judged factors in table 3.20 indicate such thinking. Therefore, one approach which could be followed is to relate ones estimate of yield drift levels to design drift levels.

A second approach to estimating drift to yield involves conducting an analytical study of one of the building stories. This study should be consistent with the analytical modeling assumptions which were discussed in section 3.4E. That is, if a story stiffness model is used then only column stiffness should be considered and drift to yield should correspond to beam-column, shear wall, a braced frame, etc, values. However, if the detailed analytical building model is used then a more refined story model is appropriate. Axial shortening and joint rotation should be included. One approach to analytically modeling such a story drift to yield relates to common laboratory modeling techniques. That is, if the frame is a rectangular moment resisting frame then column mid-height inflection points allow a no moment assumption to be made. Then, detailed linear or nonlinear stiffness matrices may be used to calculate the force deflection behavior of that floor level. Nonlinear force deflection relationship of the type shown in figure 3.50 are examples. From this data one can then estimate story drift to yield by systematically using component forces-deflection relationships.

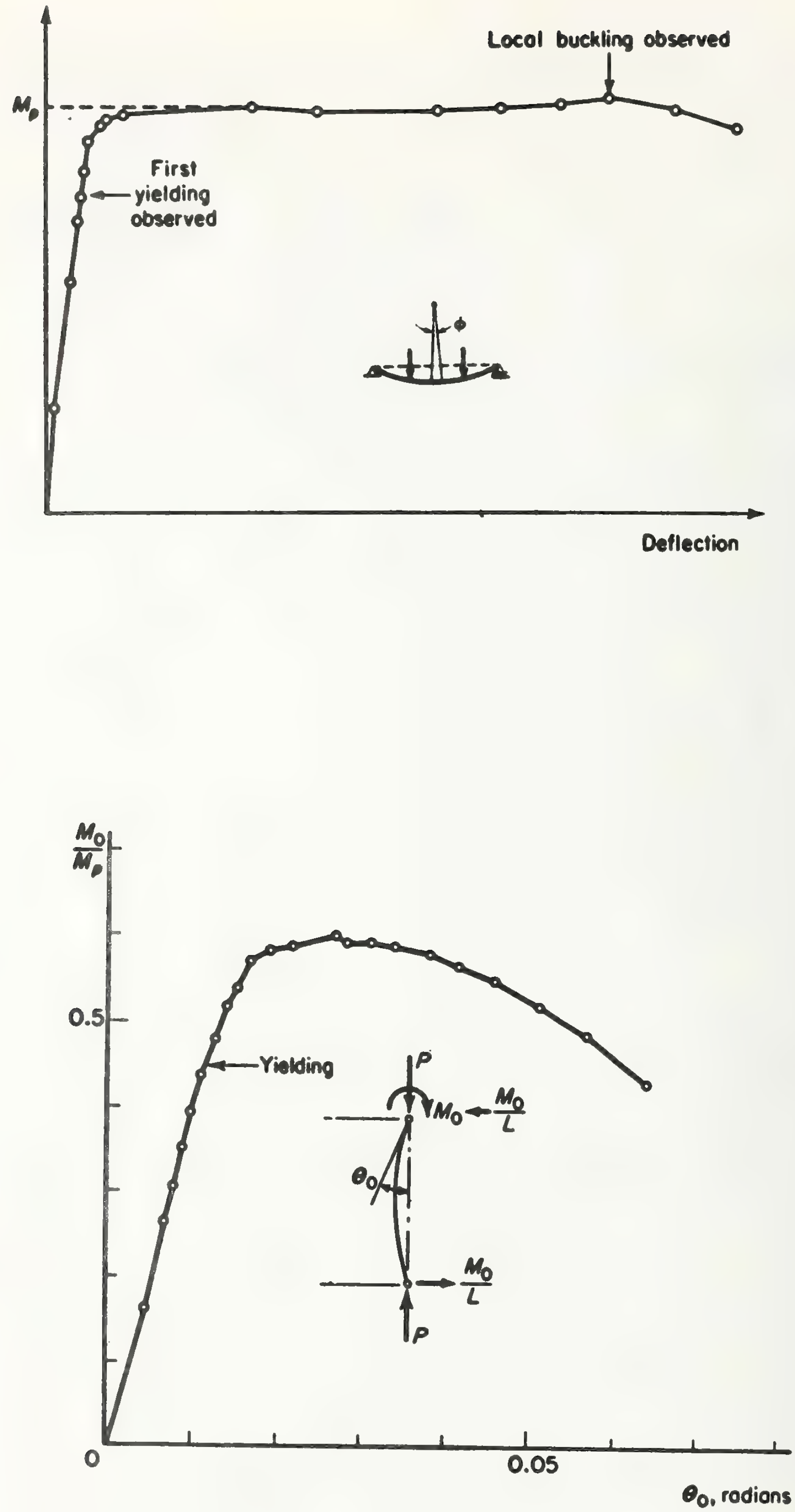


Figure 3.50 Typical Load Deflection Curves for Steel Members

Which option is correct? The approach recommended herein is to do an analytical study utilizing laboratory component test results where possible and then compare the calculated drift to yield with experience and the latest laboratory test results.

Comments on Estimating Coefficient of Variations for Input to Computer Program

This section presented three damage evaluation equations, (3.4.62), (3.4.64) and (3.4.66). Two of the equations (3.4.62) and (3.4.66) involved a coefficient of variation. The user must input to the program his estimated value of these coefficients of variation. The mathematical definition of this statistical term is straight-forward, see equation (3.4.57), and the user may use the definition to estimate the coefficient. Alternately, table 3.23 expresses the coefficient of variation is a percentage of the mean for three categories of confidence.

Table 3.22 GUIDELINES FOR UNCERTAINTY QUANTIFICATION

Level of Confidence	Coefficient of Variations as a Percent
excellent	below 5
fair	5 to 25
poor	above 25

An alternate way of quantifying this coefficient is presented in table 3.23. Therein ninety-five percent confidence range about the mean is related to the coefficient of variation. Consider for example the case where one is ninety-five percent confident that the true value of the parameter (always unknown) is between plus or minus twenty percent of the mean. It then follows that the coefficient of variation is 0.10. The numerical relationship given in this table is based upon a normal probability density function and if an alternate distribution is more appropriate a corresponding table follows directly.

Table 3.23 CONFIDENCE RANGE AND UNCERTAINTY QUANTIFICATION

Ninety Five Percent Confidence Interval about the Mean (Percent)	Coefficient of Variation as a Percent
± 10	5
± 20	10
± 30	15
± 40	20
± 50	25
± 100	50

H. WIND, TORNADO AND HURRICANE DAMAGE EVALUATION METHODOLOGIES

The damage experienced by a building during strong winds is estimated from the building interstory displacements and floor level wind pressures. The former response parameter is used to estimate structural and partition damage whereas the latter parameter is used to estimate window damage. Failure of walls due to normal pressure loading and glass breakage due to interstory drift are not considered to be significant failure modes.

Wind damage is estimated on a floor-by-floor basis and varies from zero to one hundred percent for each damage category. Analogous to the earthquake structural damage algorithm, an S-shaped curve is used to define damage variations about a mean damage value.

Tornado and hurricane damage is evaluated using the same procedure as employed for strong winds. The only difference is that instead of obtaining a site wind velocity directly from Thom's maps, see section 3.4C, the user must specify a tornado or hurricane wind velocity. To assist in the selection of such a velocity magnitude, section 3.4D provided guidelines.

Structural Damage

The ductility associated with a particular building floor is obtained by dividing the floor interstory displacement by the floor drift to yield. As discussed in section 3.4G, the drift to yield is established by the user and depends upon the quality of the building. The damage associated with the calculated ductility is obtained using an S-shaped curve identical in shape to that used in the earthquake damage algorithm. In particular, the percent damage is calculated as shown in figure 3.51 with 50% damage corresponding to $\mu_i = 1$.

A dispersion parameter is used to characterize the steepness of the curve and it is noted that this coefficient of variation or dispersion parameter, C_{vy}, is in general much smaller for wind than for seismic analysis. The selection of a value for this coefficient can be done using table 3.22 While for the earthquake problem the coefficient of variation represents the scatter in μ_c which is a function of the variables μ_f, magnitude, period and quality, in the wind analysis the scatter only depends upon the drifts to yield, i.e., Δ_y.

The wind response of a building differs from the earthquake response in the sense that the duration of strong wind loading is usually orders of magnitude greater than the earthquake strong motion. Therefore, in the development of the damage algorithm, the conservative approach taken in the wind problem assumes that if the wind response is large enough to induce yielding then the component will always have a sufficient number of cycles of motion to cause the cumulative cyclic yielding to reach to components failure level, see figure 3.47. This implies that the μ_c for wind is unity, or 50% damage at $\mu = 1$.

The equation for the percent structural damage corresponding to wind loading is written in terms of the calculated interstory drift at the ith floor, $(\Delta)_i$, and the user input interstory drift to yield, $(\Delta_y)_i$, i.e.,

$$\begin{bmatrix}\text{Percent Structural Damage}\\ \text{(ith floor)}\end{bmatrix} =$$

$$\frac{100}{\sqrt{2\pi}\,(\Delta_y)_i(C_{vy})_i}\int_0^{(\Delta)_i} \exp\left\{-\frac{1}{2}\left[\frac{Z-(\Delta_y)_i}{(\Delta_y)_i(C_{vy})_i}\right]^2\right\} dZ \qquad (3.4.67)$$

Nonstructural Damage - Partitions

The partition damage during strong winds, tornados or hurricanes is estimated in the same manner as the structural damage. The only difference is in the numerical values of the input interstory drifts to yield. Therefore, equation (3.4.67) is again used but with $(\Delta_y)_i$ and (C_{vy}) being the drift to yield and the coefficient of variation for partitions.

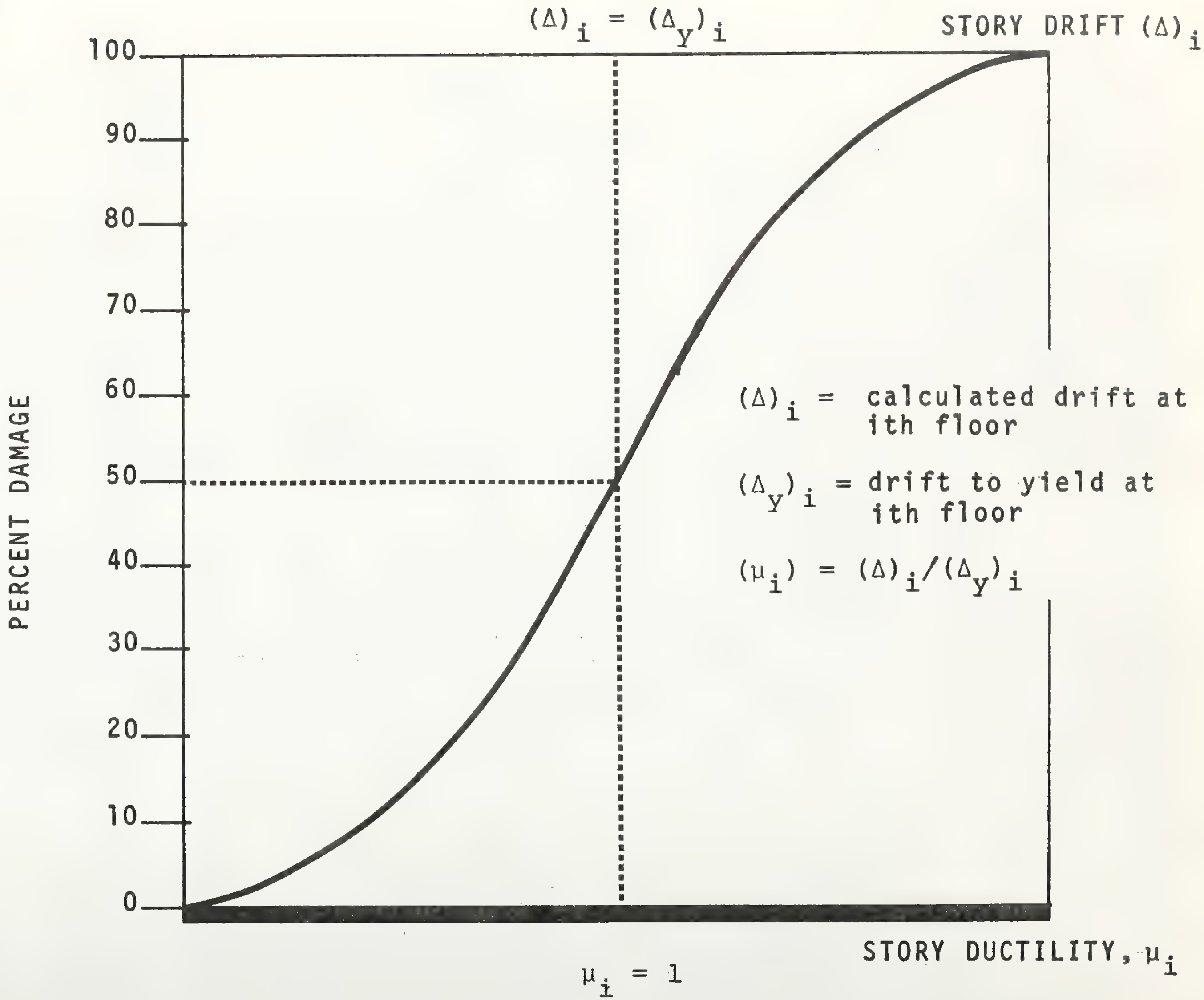


Figure 3.51 Structural Damage Versus Ductility

Nonstructural Damage - Windows

The percent of windows which break at a particular floor depends upon the wind pressure at the floor level plus the window's physical parameters. In particular the pressure required to break a window in flexure is (see [3.60])

$$p_o = \text{breakage pressure} = \frac{\alpha_G t^2 \left[1 + 1.61 (a^3/c^3)\right]}{0.75 a^2} \qquad (3.4.68)$$

where

σ_G = mean breaking stress of glass (lb/in^2)

a = minimum glass dimension, either h or b (in)

c = maximum glass dimension, either h or b (in)

b = average window width (in)

h = average window height (in)

t = glass thickness (in)

Analogous to the structural and partition damage an S-shaped curve is used to evaluate the percent damage. The fifty percent damage level is at a window pressure equal to p_o and a coefficient of variation or dispersion coefficient, C_{vG}, is input by the user.

The equation for the percent window breakage at the ith building floor is:

$$\begin{bmatrix}\text{Percent of Windows Broken} \\ \text{(ith floor)}\end{bmatrix} =$$

$$\frac{100}{\sqrt{2\pi}\,(p_o)_i (C_{vG})_i} \int_0^p \exp\left\{-\frac{1}{2}\left[\frac{Z - (p_o)_i}{(p_o)_i (C_{vG})_i}\right]^2\right\} dZ \qquad (3.4.69)$$

where

p = wind pressure (lbs/in^2)

In calculating $(p_o)_i$ for the ith floor the average values of the glass parameters for that floor are used in equation (3.4.68). The computer program estimates the percentage of corner windows damaged using corner pressure values and the percentage of non-corner window damage using the corresponding pressure values.

I. LONG SPAN ROOF DAMAGE EVALUATION

General Comments

Before beginning this part of the study, roof damage information of a statistical nature was gathered in order to determine the critical parameters which affect failure. C. Wayne Parish, President of Haag Engineering Co. of Dallas, Texas and Jack Janney of Wiss, Janney, Elstner and Associates of Northbrook, Illinois searched their extensive files and completed forms of the type shown in figures 3.52 and 3.53. Both of these companies have extensive experience in damage inspection and evaluation for insurance companies and other organizations who require a high level diagnosis of failure causes.

Table 3.24 describes roof failures due to severe wind. The following conclusions are made:

- Roof peeling is by far the primary mode of failure.
- Roofs collapse in winds, primarily due to water ponding from debris clogging the drains, or wall failure.
- Structural members of the roofing system rarely fail, and then only moderately under severe (200+ mph) winds.
- Roof fly-off is rare.

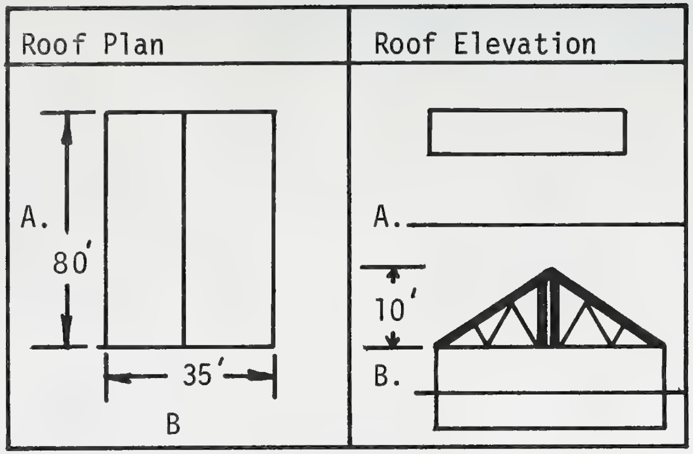
Methodology

In evaluating the damageability in this case, the methodology assumes that the roof will:

- fly off due to uplift, or
- collapse due to ponding.

Failure by wall collapse due to interstory drift would be automatically accounted for in the structural damage portion of the program. Also, the possible peeling of the roof covering is not considered since it does not cause a major financial loss or a potential loss to life.

Of special modeling consideration is the roof where uplift may cause a serious failure. The determination of the probable risk associated with such a failure is highly dependent upon roof connection details. Therefore, the computer program creates an uplift model for roof risk evaluation. This model, admittedly simple, assumes that the roof is infinitely rigid and sums the capacity of all the connection elements which restrain the roof from uplift. This total vertical resistive force is then compared with the uplift forces on the roof and the computer program calculates whether or not the roof could fly off.



Betsy Case # 3

A. MATERIAL TYPE

Truss 2 x 8 Wood Truss

Decking 1 x 8

Roofing Composition Shingles

B. FAILURE MODE*

(1) Roofing only peels off

estimate 5 % of roofing

(2) Roofing & decking peels off

estimate ______ % of roofing & decking

(3) Local truss members fails

estimate ______ % of members

(4) Local truss joint failure

estimate ______ % of joints

(5) Entire system flies off

estimate ______ % of connections failed

C. DAMAGE ESTIMATE TO BUILDING & CONTENTS

90% $\left(\frac{\text{Repair \& replacement cost}}{\text{Present worth}}\right)$

Roof pretty much in tact. Walls caved in on windward side.

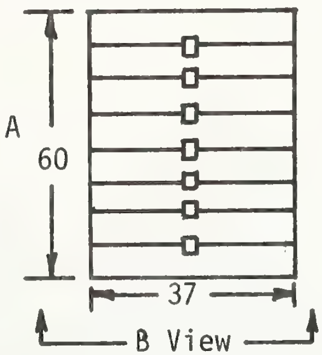
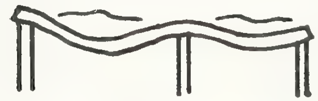
D. MAXIMUM WIND VELOCITY ESTIMATE

110 MPH Gusts to 160

E. RAIN ASSOCIATED WITH B-3 & 4?

yes ✓ no ______

Figure 3.52 Sample Survey of Roof Failure

Roof Plan	Roof Elevation
	 A. View B. ________

Beaulah Case # 2

A. MATERIAL TYPE

Decking 1 x 12 Laminated Wood Beam

Roofing Asphalt, felt and gravel

B. FAILURE MODE* - debris stopped up drains, water accumulation collapsed roof

(1) Roofing only peel off

estimate ________ % of roofing

(2) Roofing and decking peels off

estimate ________ % of roofing & decking

(3) Local web failure

estimate ________ % of frame repair

(4) Local flange failure

estimate ________ % of frame repair

(5) Entire system flies off

estimate ________ % of connections fail

C. DAMAGE ESTIMATE TO BUILDING & CONTENTS

100 % $\left(\frac{\text{Repair \& replacement cost}}{\text{Present worth}}\right)$

D. MAXIMUM WIND VELOCITY ESTIMATE

80 MPH Gusts to 120

E. RAIN ASSOCIATED WITH B-3 & 4

yes ✓ no ________

Figure 3.53 Sample Survey of Roof Failure

Table 3.24 ROOF DAMAGE SURVEY RESULTS

Case No.	Roof Type	Plan Dimensions (ft)	Span Support To Support (ft)	Wind Velocity (mph)	Roof Failure Type	Roof Damage By Type (%)	Remarks
1	Lamella Dome	?	?	60+gusts	Roofing peeling	1	Severe water damage
2	Laminated Wood Beam	60 x 37	19	80-120	Collapse due to water ponding	100	Debris stopped up drains, causing ponding. Hurricane Beulah
3	Wood Truss	35 x 80	35	110-160	Roofing peeling	5	Walls caved in on windward side, roof intact, 90% damage to structure
4	Wood Truss	60 x ?	60	80-120	None	100	Wall collapse due to tide, Hurricane Beulah
5	Wood Truss	90 x 120	23	80-120	Roofing & decking peeling	10	5% damage to structure
6	Steel Truss	70 x 110	70	160	Roofing & decking peeling	60	50% damage to structure
7	Steel Truss	90 x 150	90	160	Roofing & decking peeled off	100	60% damage to structure
8	Wood Beams	60 x 120	20	80-120	None	0	Water accum. sagged roof
9	Concrete	?	?	40-60	Roofing peeling	75	Less than 1%
10	Bar Joist	85 x 140	?	60	Roofing & decking peeling	Roof 35, Deck 15	
11	Precast, Prestressed Gull Wing Tees	70 x 160	70	200+	Some beam failure	6	100% damage due to window breakage, destroyed contents
13	Precast, Concrete Slabs	80 x 80	8	75	Roofing only peeling off	25	

Collapse due to ponding is simply treated by requiring the user (1) to estimate the total depth of ponding that can occur per vertical load carrying member (e.g., truss spacing), (2) to state whether or not rain accompanies the wind, (3) to judge the quality rating of the roof in relationship to the code loads that should be resisted by the design, and (4) to define the dead load per vertical load carrying member. The program then simply computes whether or not the roof could collapse due to wind-driven rain ponding on the roof. Guidance on the effect of roof flexibility on the depth of ponding is given in Ref. [3.63].

Quality Rating Techniques

The evaluation of long span roof systems is based on the premise that the structure was originally designed according to the requirements of the governing building codes. If the structure does not appear to be seriously deficient when visually surveyed, it should be assumed to have been adequately designed. The capacity of the structure to carry the design code loads should then be assumed sufficient.

The evaluation of the structure should point out any major deficiencies in the original design, and it should give a survey of the present condition of the structure. The major portion of the evaluation will be a field examination of the building with some office calculations to check the elements that seem to be lacking in strength. Some of the more important items that should be evaluated are described in the following paragraphs for wood, steel, and concrete long span roofs. The following points refer to a good, Q=3, quality roof design.

- Wood trusses:

  Wood trusses are common load carrying members for long span roofs. If the following items appear to conform to code design requirements, the truss should be able to easily carry the design vertical loads with an appropriate factor of safety:

  (a) The wood members should be sound and free from weakening cracks.

  (b) The connections should not appear to have been overloaded by showing signs of slipping or having bearing failures.

  (c) The chord members should be adequately braced perpendicular to the plane of the truss by struts or bracing to keep the chords in line.

  (d) The bolts should be tight.

  (e) The connections to the columns or walls should appear free from movement or distress.

  (f) The truss should not have excessive sag.

- <u>Steel Trusses and Girders</u>:

  Steel trusses and girders are common load carrying members for long span roofs when properly designed and detailed. The following items should be checked to evaluate the condition of the steel truss or girder:

  (a) The elements should be sound, straight, and free from visual damage.

  (b) The bolted connections should be tight.

  (c) The chords of the truss or flanges of the girder should be stayed properly by either bracing or struts perpendicular to the plane of the truss or girder.

  (d) The connections to the columns or walls should appear to have had no movement or distress.

- <u>Concrete and Wood Arches</u>:

  Concrete and glue laminated wood arches are not a common load carrying member for long span roofs, but there are some throughout the country and should be evaluated for the following items:

  (a) The members should be free from visual damage or overstress.

  (b) The supports should appear solid and free from lateral movement.

  (c) A solid buttress or tie rod is required for the horizontal forces at the heel of the arch.

- <u>Concrete and Wood Girders</u>:

  Concrete girders may be either of the typical reinforced type or of the prestressed or post-tensioned type. Wood girders for long spans are usually glue laminated straight or cambered members. These girders need to be evaluated for the following two items:

  (a) The members should be free from visual damage.

  (b) The connections to the walls or columns should be free from signs of overstress or movement.

The quality rating factors used in section 3.4G can be used to degrade the capacity of the structural systems described above in the same proportions as estimated in table 3.19 for Structural Systems. The judged degradation values for the various Q values are listed below and are only given as guidelines:

Q	Vertical uplift load capacity	Vertical downward load capacity
3	1.5 x code	1.5 x code
2	1.0 x code	1.0 x code
1	0.5 x code	0.5 x code

Description of Damage Evaluation Procedure

- Uplift: The user has 3 options as to the specifications of uplift forces.

  Option A: Forces calculated under option A make use of internally stored pressure coefficients for symmetrical gabled roofs assuming a zero wind angle. The pressure coefficients are formed after the general specifications of the Swiss Building Code [3.35], see table 3.25.

  User Input: a) angle of roof, α, (degrees) b) total vertical load capacity (dead load + connection resistance)

  Output: program compares roof forces calculated internally with user input AND determines whether roof is ON or OFF.

  Option B: Forces calculated under option B again make use of internally stored pressure coefficients for symmetrical roofs with a zero wind angle. The pressure coefficients are formed after the general specifications of the ANSI-A58-1972 standard [3.2] table 3.26.

  User Input: Same as Option A

  Output: Same as Option A

  Option C: If the user desires a more detailed approach, he is given the option of specifying pressure coefficients for the individual building. An example of such a specification is shown in Figure 3.54 as derived from the Swiss Wind Tunnel Tests [3.35]. The user must bear in mind that the coefficients shown apply only to buildings with the shape and configurations designated.

  User Input: Same as Option A plus a vector of the pressure coefficients shown in the figures

  Output: Same as Options A & B

- Collapse: The user estimates the dead load of the roof including frame. The user estimates the mean depth in feet of ponding that could occur if all drains are plugged. The computer program computes total water load, adds it to the dead load and compares it to the downward vertical load carrying capacity related to code which is specified by the user. If the former loads exceed the latter capacity then the roof collapses.

Table 3.25 GENERAL SPECIFICATIONS FROM SWISS CODE FOR CLOSED BUILDINGS WITH RECTANGULAR PLAN, WIND DIRECTION=0°

$2/5 \leq L/B \leq 5/2$

$2/3 \leq B/M \leq 3/2$

	Windward Slope (E)		
	$0° \leq \alpha \leq 20°$	$20° \leq \alpha \leq 50°$	$50° \leq \alpha \leq 85°$
Pressure Coefficient	-1.0	$\frac{(5\alpha - 200)}{100}$	$\frac{\alpha}{100}$

	Leeward Slope (F)
	$0° < \alpha < 85°$
Pressure Coefficient	-0.7

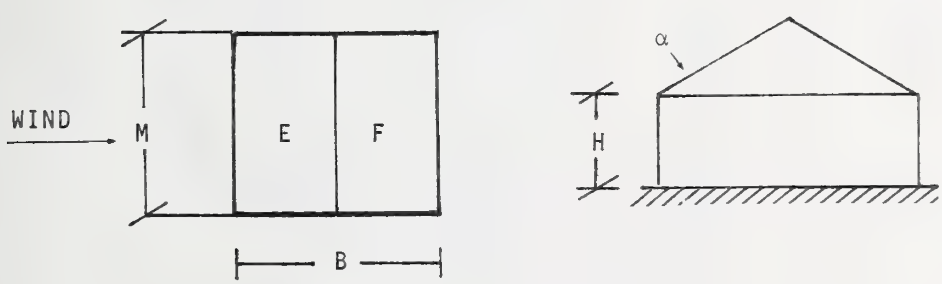


Table 3.26 ANSI A58.1 - 1972 [3.2] EXTERNAL PRESSURE COEFFICIENTS FOR ROOFS

H/w	Windward Slope								
	10° - 15°	20°	25°	30°	35°	40°	45°	50°	≥ 60°
≤0.3	.010*	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.010
0.5	-1.0	-0.75	-0.5	-0.2	0.05	0.3	0.45	0.5	0.010
1.0	-1.0	-1.0	-0.8	-0.55	-0.3	-0.05	0.2	0.45	0.010
>1.5	-1.0	-1.0	-1.0	-0.9	-0.6	-0.35	-0.1	0.2	0.010

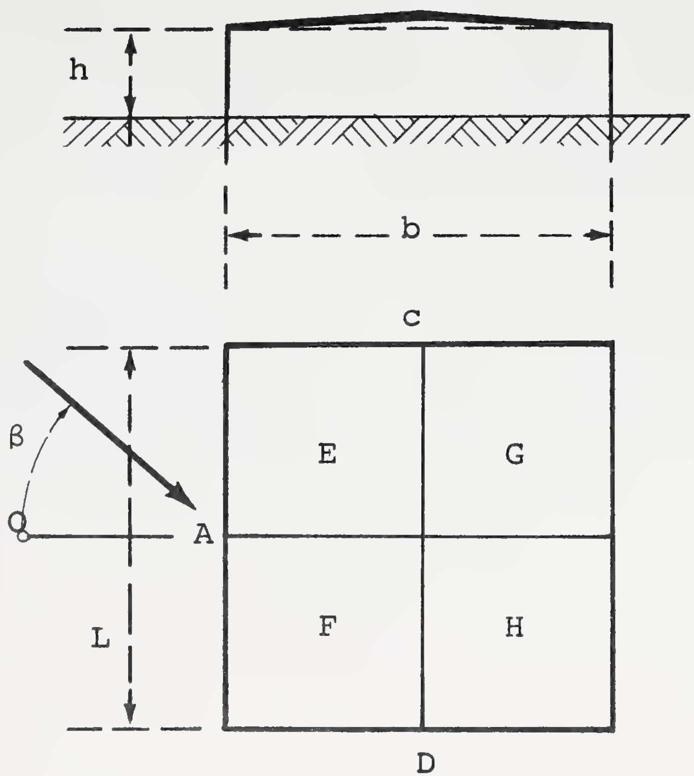
*if H/w = 0 then use $c_p = -1.0$

Leeward Slope - $c_p = -0.7$

w = least building width (either B or H)

H = building height

ROOFS 0-3°



EXT PRESS COEF Cpa FOR h:b:l=1:4:4

β	A	B	C	D	E	F	G	H
0°	+0.9	-0.3	-0.4	-0.4	-0.8	-0.8	-0.3	-0.3
45°	+0.5	-0.4	+0.5	-0.4	-0.9	-0.6	-0.6	-0.3
90°	-0.4	-0.4	-0.9	-0.3	-0.8	-0.3	-0.8	-0.3

Figure 3.54 Example of Uplift Forces for Various Types of Roofs and Wind Directions [3.40]

4. DEMONSTRATION OF HAZARD EVALUATION METHODOLOGY

4.1 INTRODUCTION

This chapter presents the damage evaluation analysis of a two-story building using each of the three evaluation methods described in chapter 3. Additional examples demonstrating the use of the three methods are presented in Appendix D.

The building is a reinforced concrete office building. Roof and floor systems utilize reinforced concrete joists and girders and lateral force resisting elements consist of concrete shear walls which are non-loadbearing. The building has a complete vertical load-carrying concrete frame. The thin, architectural precast concrete panels with exposed aggregate are a veneer and were used as a form for the poured concrete walls. The anchorage of these panels is considered to be excellent. The results of the damage evaluation obtained using the three methods are presented in section 4.6.

4.2 DATA COLLECTION FORM (DC FORM)

The data collection form which are completed for this building are given in this section. The information in DC Form is used for the Field Evaluation Method and the Approximate Analytical Method.

DATA COLLECTION FORM
NATURAL HAZARDS EFFECTS
(Extreme Winds, Earthquakes)

A. GENERAL DATA

*1. Facility No. R.C. BUILDING 2. Building Name ______

3. Address — 4. City —

5. State — 6. Zip Code — 7. Year Built —

8. Date of Major Modifications or Additions, if any —

9. Building Code Jurisdiction: City [✓] County [ ] State [ ] Federal [ ]

*10. Latitude — *11. Longitude —

12. Current Bldg. Use OFFICE Orig. Bldg. Use SAME

13. Basement Yes ✓ No ___ Number of Basements 1

No. of Stories Above Basement 2 (See also Item A23)

14. Height of First Story 14'-0" ft.

15. Upper Story Height 14'-0" ft. Special Story Height NONE ft.

16. Is the exterior of first story different from upper stories?

Street Front Side Yes ___ No ✓ Other Sides Yes ___ No ✓

17. Approximate Roof Overhang Distance 1'-8" Side ALL SIDES

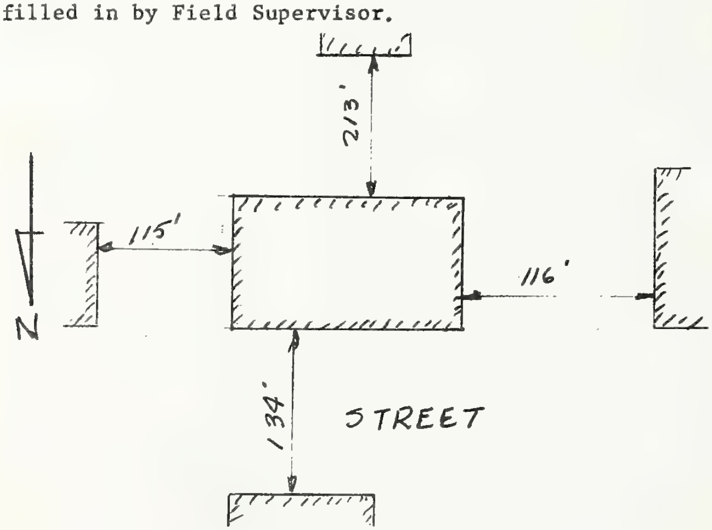
18. Proximity to Adjacent Buildings: Sketch Below with North Arrow

North Side 134' South Side 213' East Side 115' West Side 116'

Note Street or Alley Sides STREET ON NORTH

*To be filled in by Field Supervisor.

Sketch



19. Are plans available? YES If so, where obtainable ARCHITECT

________ Are original calculations available? YES If so,

where obtainable ENGINEER

Name of: Architect ________ Engineer ________

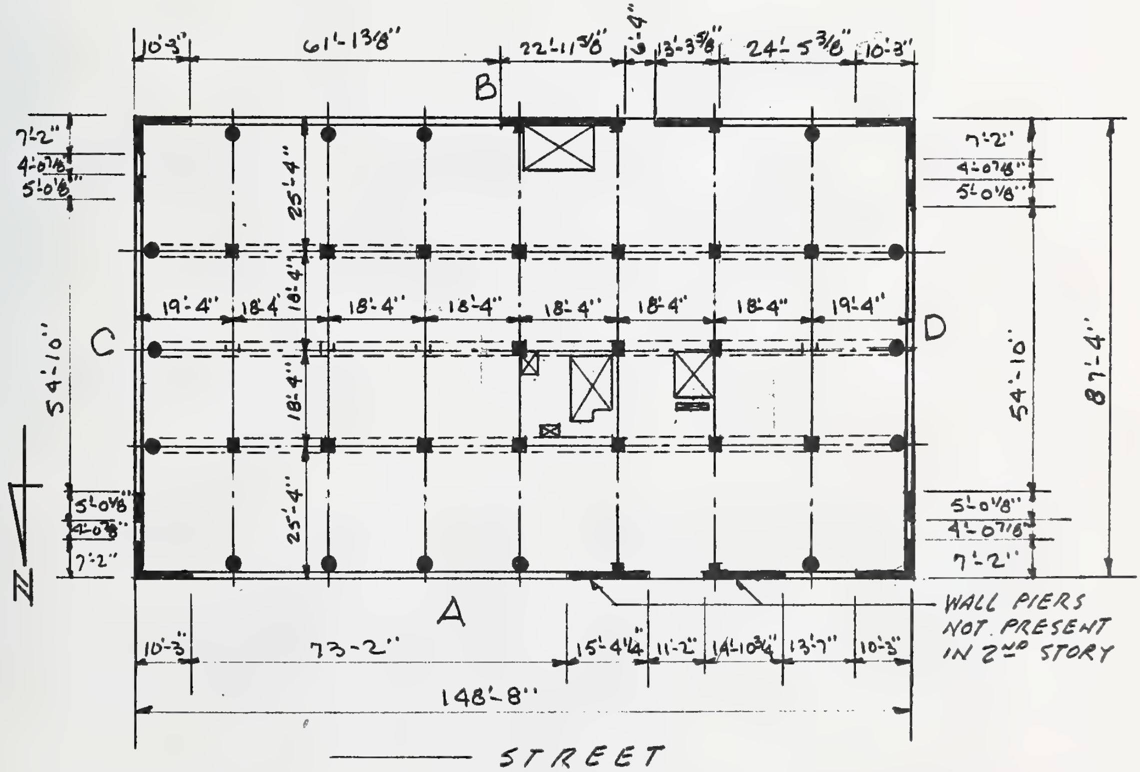
Contractor ________

Regulatory Agency CITY

20. Basic Building Plan

a. Sketch overall plan.
b. Locate shear walls, if any.
c. Locate main frames.
d. Locate expansion joints, if any.
e. Give approximate north arrow and label sides "A", "B", "C", "D", etc. Show street or alley sides.
f. Note any common or party walls.
g. If plan changes in upper floors, sketch this plan and note level of change.

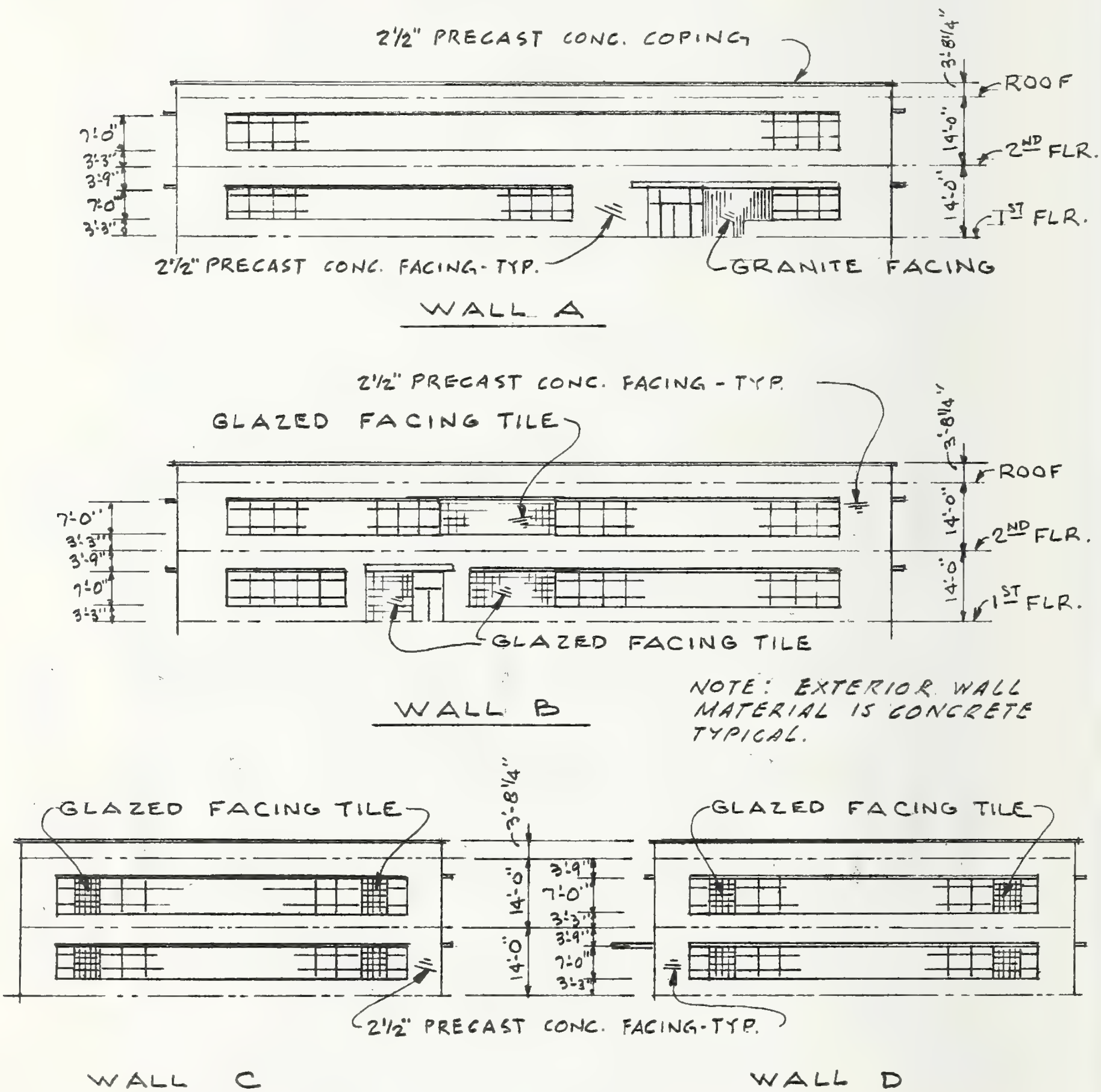
(Use additional sheet if necessary)



21. Elevation of Exterior Walls.

Sketch:
- a. All openings or note pattern of openings.
- b. Note exterior finish and appendages.
- c. Note material of walls.
- d. Major cracks or other damage. (Note if cracks are larger at one end.)
- e. Note previously repaired damage.
- f. Note any evidence of damage to cladding or appendages.

(Use additional sheet if necessary)



22. Elevation of Interior Shear Walls. NONE

Sketch: a. All openings.
b. Major cracks or other damage. (Note if cracks are larger at one end.)
c. Note any previously repaired damage.

23. Adaptability of Basement to Storm Shelter.

a. Floor Over Basement - Concrete [x] Other [ ]

b. If concrete, give thickness JOIST & SLAB - 12" JST + 3" SLAB

c. Available Space (approximate) 9,500 sq. ft.

d. Dangerous Contents. Storage of Flammable Liquids [ ]

Presence of Transformers or Other Dangerous Equipment [ ]

Other Hazards ______

None [x]

24. Is this a Vault-like Structure? Yes [ ] No [x]

25. EXTERIOR WALL SUMMARY SHEET

Exterior Characteristics	Side A	Side B	Side C	Side D
Extensive Architectural Ornaments or Veneer	✓	✓	✓	✓
WALLS Metal Curtain Wall				
Precast Concrete Curtain Wall				
Stone				
Brick				
Concrete Block				
Concrete	✓	✓	✓	✓
Other				
For Concrete Block and Brick, indicate R for Running Bond S for Stacked Bond				
Condition of Wall*				
OPENINGS Percent of Open Area per Story	2ND = 43% 1ST = 35%	2ND = 35% 1ST = 32%	2ND = 36% 1ST = 36%	2ND = 36% 1ST = 36%

*1. No cracks, good mortar.
2. Few visible cracks.
3. Many cracks
4. Evidence of minor repairs.
5. Evidence of many repairs.

B. SITE RELATED INFORMATION

1. Exposure

   a. Centers of large city [ ] b. Very rough hilly terrain [ ]

   c. Suburban areas, towns, city outskirts, wood areas, or rolling terrain [ ] d. Flat, open country [✓]

   e. Flat coastal belts [ ] f. Other [ ]

2. Topography

   a. Building on level ground [✓] b. Building on sloping ground [ ]

   c. Building located adjacent to embankment [ ]

*3. Geologic formation —

*4. Location of known faults: Name — Miles —

   ______ Miles ______

*5. Depth of water table — ft. When measured: — (Month) — (Year)

*6. Depth of bedrock — ft.

*7. Soil type — — —

*8. Bearing capacity — p.s.f., or — blows per inch

9. Proximity to potential wind-blown debris - Type LUMBER YARD

   Location ______ Distance 400'

*To be filled in by Field Supervisor.

C. STRUCTURAL SYSTEMS

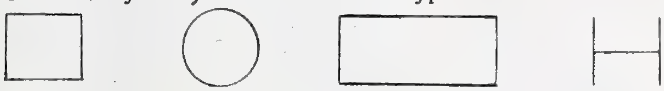
1. Material

Concrete [x] Masonry [ ] Steel [ ] Wood [ ]

2. Vertical Load Resisting System

Frame [x] Bearing Wall [ ] Wall and Pilasters [ ]

For frame system, check one for typical column cross-section



[x] [ ] [ ] [ ] Other [ ]

3. Lateral Load Resisting System

Masonry Shear Wall [ ]
Concrete Shear Wall [x]
Plywood Shear Wall [ ]

Braced Frame [ ]
Moment Resisting Frame [ ]
Are resisting systems symmetrically located? Yes [x] LOWER STORY No [x] UPPER STORY

4. Floor System

Frame

Concrete Beams [x]
Steel Beams [ ]
Steel Bar Joist [ ]
Wood Beams [ ]
No Framing Members [ ]
Precast Concrete Beams [ ]

Deck

Concrete Flat Plate [ ]
Concrete Flat Slab [ ]
Concrete Waffle Slab [ ]
Steel Deck [ ]
Wood Joists [ ]
Wood Plank [ ]
Straight Sheathing [ ]
Plywood Sheathing [ ]
Diagonal Sheathing [ ]
Precast Concrete Deck [ ]
Concrete Joists [x]
Concrete Plank [ ]

Note if concrete topping slab is used over metal decks or concrete plank.

Connection Details

	Framing	Decking To Framing
Bolted	☐	☐
Welded	☐	☐
Metal Clips	☐	☐
Wire Fastener	☐	☐
No Connection	☐	☐
Nailed	☐	☐
Metal Hangers	☐	☐

Anchorage Floor to Walls

Type REINFORCING BARS

Spacing 3'± NORTH & SOUTH WALLS — 18" o.c. EAST & WEST WALLS

5. Roof System

Frame

Concrete Beams	☑	Steel Truss	☐
Steel Beams	☐	Wood Truss	☐
Steel Bar Joist	☐	No Framing Members	☐
Wood Beams	☐	Precast Concrete Beams or Tees	☐
Wood Rafters	☐		

Deck

Concrete Flat Slab	☐	Concrete Waffle Slab	☐
Metal Decking	☐	Plywood Sheathing	☐
Concrete Slab	☐	Diagonal Sheathing	☐
Concrete Joists	☑	Straight Sheathing	☐
Precast Decking	☐	Concrete Fill	Yes ☐ No ☑

Connection Details

	Framing	Decking to Framing
Bolted	☐	☐
Welded	☐	☐
Metal Clips	☐	☐
Wire Fastener	☐	☐
No Connection	☐	☐
Nailed	☐	☐
Metal Hangers	☐	☐

Anchorage Roof to Walls

Type REINFORCING BARS

Spacing 3'± NORTH & SOUTH WALLS – 18" o.c. EAST & WEST WALLS

D. NONSTRUCTURAL ELEMENTS

1. Partitions

Type

	Typical	Corridor
Partial Height	☐	☐
Full Height Floor-To-Ceiling	☐	☐
Floor To Floor	☑	☑
Movable	☐	☐

Composition

Lath and Plaster ☑ - STEEL STUDS

Gypsum Wallboard ☐

Concrete Block ☐

Clay Tile ☐

Metal Partitions ☐

2. Ceiling

Typical Room

Material

Acoustical Tile [✓] Gypsum Board [ ] Plaster [ ]

Method of Attachment

Suspended [✓] Metal Channels [ ] Tee Bar Grid [✓]

Attached Directly to Structural Elements [ ]

Typical Corridor

Material

Acoustical Tile [✓] Gypsum Board [ ] Plaster [✓]

Method of Attachment

Suspended [✓] Metal Channels [✓] Tee Bar Grid [ ]

Attached Directly to Structural Elements [ ]

3. Light Fixtures

Typical Room

Recessed [✓] Surface Mounted [ ] Pendant (Suspended) [ ]

Typical Corridor

Recessed [✓] Surface Mounted [ ] Pendant (Suspended) [ ]

4. Mechanical Equipment

Location of Mechanical Equipment Room

Basement [✓] Other Floor [✓] Which Floor 1ST & 2ND

Roof [ ]

Is Equipment Anchored to Floor? No [ ] Yes [✓]

Location of The Following Units

Liquid Storage Tank ____________________

Cooling Tower OUTSIDE OF BLD'G

Air Conditioning Unit 1ST & 2ND FLOOR

5. Roofing

Description

Flat ☑ Arched ☐ Gabled ☐ If arched or gabled, sketch section.

Pitched ☐ Slope (:12)

Parapet No ☐ Yes ☑ Height (3 ft. 8¼ in.) Thickness (8½ in.)

Material 6" CONC. Special Anchorage or Bracing Yes ☐ No ☑

2½" PRECAST CONC. PANEL

Type

Built-up gravel ☑ Gravel ☐ Asphalt or Wood Shingles ☐

Clay Tile ☐ Other ☐

6. Windows

Type

Fixed ☑ Movable ☐

Frame Material:

Aluminum ☐ Steel ☑ Stainless Steel ☐ Wood ☐

Size: Average Size of Casing (6'-9" ft. x ____ ft.) SEE ELEVATIONS

Average Size of Glazing (4 ft. 0 in. x 4 ft. 5 in.)

How Casing is Attached to Structure

Bolted ☑ Screwed ☐ Clipped ☐ Welded ☐ Nailed ☐

3/8"ϕ BOLTS @ 24"o.c.

Glazing Attachment to Casing

Elastomeric Gasket ☐ Glazing Bead ☑ Aluminum or Steel Retainer ☐

Other ☐

7. Gas Connection

Flexible Connection to Building ☑ Rigid Connection to Building ☐

Automatic Shut-off ☐ None ☐ Unknown ☐

INSPECTED BY ______________________

DATE ______________________

FIELD SUPERVISOR ______________________

4.3 FIELD EVALUATION METHOD

A. Earthquake

The rating forms are completely based on the information in the Data Collection Form. From the elevation of Wall A, it will be noticed that two large concrete wall elements in the first story do not appear in the second story. A second floor plan was not drawn, but a note was placed on the first floor plan that these two piers are not present in the second story. This creates some eccentricity in the upper story vertical resisting system for longitudinal loading which is reflected in the symmetry rating.

The field investigation showed no cracks in the concrete shear walls and no evidence of cracks or looseness of the precast exposed aggregate or granite veneers. The anchorage of these veneer elements, according to the plans and specifications, appeared to be adequate.

The plans show that this building was constructed in the 1960's and the building code of that period would require earthquake resistant design.

FACILITY NO. R.C. BUILDING EXPECTED SITE MODIFIED MERCALLI INTENSITY 9.5

FIELD EVALUATION METHOD

STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

VERTICAL RESISTING ELEMENTS							
Type	General Rating (GR) E	General Rating (GR) W	Symmetry (S)	Quantity (Q)	Symmetry Quantity Rating (SQR) [1]	Present Condition (PC)	Sub-Rating (SR1) [2]
TRANSVERSE LOADING							
F	1	1	1	3	2	1	1.3
LONGITUDINAL LOADING							
F	1	1	2	3	2.5	1	1.5

FOOTNOTES:

1. Symmetry-Quantity Rating (SQR) = $\frac{S + Q}{2}$.
2. Sub-rating SR-1 = $\frac{SQR + 2PC}{3}$.

	TYPE	GENERAL RATING (GR) Earthquake	Wind
A	Steel Moment Resistant Frames	1	1
B	Steel Frames - Moment Resistance Capability Unknown	2	2
C	Concrete Moment Resistant Frames	1	1
D	Concrete Frames - Moment Resistance Capability Unknown	2	2
E	Masonry Shear Walls - Unreinforced	4	2 or 3
F	Masonry or Concrete Shear Walls - Reinforced	1	1
G	Combination - Unreinforced Shear Walls and Moment Resistant Frames	2	2
H	Combination - Reinforced Shear Walls and Moment Resistant Frames	1	1
J	Braced Frames	1	1
K	Wood Frame Buildings, Walls Sheathed or Plastered	1 or 2	2 or 3
L	Wood Frame Buildings, Walls Without Wood Sheathing or Plaster	4	4

SYMMETRY (of Resisting Elements)

1	Symmetrical
2	Fairly Symmetrical
2 or 3	Symmetry Poor
3 or 4	Very Unsymmetrical

NOTE: Add 1 (not to exceed 4) to each rating if a high degree of vertical non-uniformity in stiffness occurs.

QUANTITY (of Resisting Elements)

1	Many Resisting Elements
2	Medium Amount of Resisting Elements
3	Few Resisting Elements
4	Very Few Resisting Elements

NOTE: If exterior shear walls are at least 75% of building length, this rating will be 1.

PRESENT CONDITION (of Resisting Elements)

1	No Cracks, No Damage
2	Few Minor Cracks
3	Many Minor Cracks or Damage
4	Major Cracks or Damage.

NOTE: If masonry walls, note quality of mortar - good or poor. If lime mortar is poor, use next higher rating.

FIELD EVALUATION METHOD

STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

HORIZONTAL RESISTING ELEMENTS						
Type		Rigidity (R)	Anchorage & Connections (A)	Chords (C)		Sub-Rating (SR2)
				Longitudinal	Transverse	
Roof	A	1.	1	1	1	1
Floors	A	1.	1	1	1	1

Note: Sub-rating SR2 = Largest of R, A or C.

Type

A Diaphragm
B Steel Horizontal Bracing

Rigidity - Ratings

1. Rigid
1.5 Semi-rigid
2.0 Semi-flexible
2.5 Flexible

Anchorage and Connections - Ratings

1 Anchorage confirmed - capacity not computed, but probably adequate.
2 Anchorage confirmed - capacity not computed, but probably inadequate.
3 Anchorage unknown.
4 Anchorage absent.

Chords - Ratings

1 Chords confirmed, but capacity not computed.
2 Chords unknown, but probably present.
3 Chords unknown, but probably not present.
4 Chords absent.

FACILITY NO. R.C. BUILDING

FIELD EVALUATION METHOD

EXIT CORRIDOR AND STAIR ENCLOSURE WALLS - EARTHQUAKE RATING

TYPE OF WALL	REINFORCEMENT			ANCHORAGE					WALL RATING
	Present	Not Present	Not Known	Mortar Only	Dowels	Screws or Bolts	Other	Not Known	
Brick									
Brick									
Concrete Block									
Concrete Block									
Reinforced Concrete									
Tilt-up or Precast Concrete									
Steel Studs & Plaster						✓			A
Wood Studs & Plaster									
Hollow Tile									
Hollow Tile & Plaster									

NOTE: Wall Rating on Basis of A, B, C, and X.

FORM FMB-1

FIELD EVALUATION METHOD

OTHER LIFE HAZARDS - EARTHQUAKE RATING

TYPE OF RISK	RATING
Partitions Other Than on Corridors or Stair Enclosures	A
Glass Breakage	B
Ceiling	B
Light Fixtures	B
Exterior Appendages and Wall Cladding*	A

Ratings
A = Good
B = Fair
C = Poor
X = Unknown

*A description of some of the ratings for Exterior Appendages and Wall Cladding are:

Description	Rating
Spacing of anchors appears satisfactory	A
Size and embedment of anchors satisfactory	A
Spacing of anchors appears to be too great	B
Size and embedment of anchors appears unsatisfactory	C
Anchorage unknown	X
Anchorage corroded or obviously loose	C
No anchorage	C

EARTHQUAKE GAS CONNECTION		
Present	Not Present	Not Known
✓		

B. <u>Wind</u>

This two-story, reinforced concrete structure is exposed to a basic wind speed of 100 miles per hour with Exposure "C."

The comments in the preamble for earthquake relative to location of shear walls and attachments of precast concrete panel veneer are also applicable to wind evaluation.

The information necessary for evaluation of the structural system is given with the earthquake evaluation on Form FMA-1.

FACILITY NO. R.C. BUILDING

FIELD EVALUATION METHOD

STRUCTURAL SYSTEM - WIND RATING

BUILDING DESIGNATION:

* Exposure A, B or C	* Basic Wind Speed (V_2)	Building Height	* Effective Velocity Pressure (q_F)	**** Design Unit Pressure q_Fx1.4=P	** Basic Structural Rating	Uplift Anchorage Factors: Foundation	Uplift Anchorage Factors: Roof	*** Corrected Structural Rating	Effective Unit Velocity Pressure Capacity P_c	Capacity Ratio $\frac{P}{P_c}$
B	100	32'	33	43	1.5	1	1	1.5	40	1.1

* See ANSI A58.1-72. q_F in pound per square foot.
** From Structural Systems - Form FME.
*** Use Maximum Anchorage Factor (Foundation or Roof) or the Basic Structural Rating, whichever is greater.
**** q_F x 1.3 = P for buildings with height to length ratio less than 2.5.

ANCHORAGE FACTORS

BUILDING TYPE	UPLIFT ANCHORAGE TO FOUNDATION	FOUNDATION ANCHORAGE FACTOR[1]	UPLIFT ANCHORAGE OF ROOF	ROOF ANCHORAGE FACTOR[1]
Heavy Buildings	Good	1.0	Good	1.0
Heavy Buildings	Poor	1.5	Poor	4.0
Light Buildings	Good	1.0	Good	1.0
Light Buildings	Poor	4.0	Poor	4.0

CORRECTED STRUCTURAL RATING	P_c
1. -	45
1.1 to 1.5	40
1.6 to 2.0	30
2.1 to 3.0	20
3.1 to 3.5	10
3.6 to 4.0	5

[1]Factors should be increased 0.5 (not to exceed 4.0) if the building is primarily un-enclosed.

FORM FMC-1

FACILITY NO. R.C. BUILDING FORM FMC-2

FIELD EVALUATION METHOD

OTHER LIFE HAZARDS - WIND RATING

TYPE OF RISK	RATING
Glass Breakage	B
Window Frame Anchorage	B
Roof Panel Anchorage	A
Wall Panel Anchorage	A
Anchorage of Exterior Appendages	A

A = Good; B = Fair; C = Poor; X = Unknown.

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE

TYPE	QUANTITY	DISTANCE
LUMBER YARD	LARGE	400'

C. Tornado

The building is assumed to be in a location subject to tornado hazard. The basis used for tornado evaluation is the information obtained in wind evaluation and is shown on Form FMC-1 and FMC-2. Using this information, the tornado ratings are placed on Form FMD. Form FMD only rates buildings capable of sustaining an effective unit velocity pressure of 40 psf or over. The tornado wind pressures, both positive and negative, are much higher than this. However, the relatively short duration of extremely high tornado wind forces is recognized in these ratings on Form FMD.

FACILITY NO. R.C. BUILDING

FORM FMD

FIELD EVALUATION METHOD

TORNADO RATING

EFFECTIVE UNIT VELOCITY PRESSURE CAPACITY P_c (From FMC-1)	DOES BUILDING QUALIFY AS A VAULT-TYPE STRUCTURE?		TORNADO RATING BUILDING-AS-A-WHOLE
40	Yes ☐	No ☑	FAIR

BUILDING-AS-A-WHOLE RATINGS

Vault Type Building - Good
P_c = 40 p.s.f. or over - Fair
P_c = 20 to 40 p.s.f. - Poor
P_c = Under 20 p.s.f. - Very Poor

HAZARD FROM WIND-BLOWN DEBRIS				
	LOCATION	TYPE	NOT PRESENT	RATING
Wall Cladding, Appendages, or Glass	VENEER ALL SIDES WINDOWS ALL SIDES	PRECAST CONC. PANELS & GRANITE GLASS & ST'L SASH		GOOD POOR
Other Potential Debris Not Part of The Building			✓	

WIND-BLOWN DEBRIS RATINGS

Not Present - Good
Small Quantity of Potential Hazard - Fair
Large Quantity of Potential Hazard - Poor

BASEMENT STORM SHELTER AVAILABILITY	
Present	Yes ☑ No ☐
Capacity*	633
Suitability**	SATISFACTORY

*Based on 15 sq. ft. per person.

**See Section 3.2E.

D. Resume

Earthquake

The Field Method of Evaluation rates this building "Poor" for its ability to resist an earthquake of Modified Mercalli Scale Intensity of 9.5, which is a very severe earthquake. It would rate "Fair" for an earthquake of Modified Mercalli Scale VIII, and "Good" for an earthquake of Modified Mercalli Scale VII or less.

The steel stud and plaster partitions are rated "A" (Good). Some plaster cracking would be expected in earthquakes of MMI VI or greater. Failure of the structural elements would cause severe damage to the partitions, however.

Some glass breakage and falling of light fixtures could be expected in earthquakes of MMI VIII or greater. Some ceiling panels would probably fall in the higher intensity earthquakes.

Wind

The rating of this example is "Fair" for a Basic Wind Speed of 100 mph Very little damage to "Other Life Hazards" would be expected from winds of a Basic Wind Speed of 100 mph.

Tornado

The rating of this example for tornado is "Fair." It is a rather heavy building and the reinforced concrete roof will probably resist considerable uplift. Most of the exterior glass would be broken. The basement has an effective area to house over 600 people for a short period of time. The concrete joist system of the first floor is considered the equivalent to a solid 6 in slab.

FIELD EVALUATION METHOD

CAPACITY RATIOS - EARTHQUAKE AND WIND RATING

	General Rating (GR)	Sub-Rating SR1	Sub-Rating SR2	Basic Structural Rating*	Capacity Ratio**
EARTHQUAKE	1	1.5	1	1.5	1.5
WIND	1	1.5	1	1.5	1.1

*Basic Structural Rating = $\frac{\text{GR} + 2\ (\text{Largest of SR1 or SR2})}{3}$.

**Capacity Ratio for wind shall be obtained from Form FMC-1. For earthquake, the ratio is obtained from the Basic Structural Rating divided by the Intensity Level Factor at the site as determined from the table below.

Modified Mercalli Scale	Intensity Level Factor
VIII or Greater	1
VII	2
VI	3
V or Less	4

A description of Modified Mercalli Scale is included on table 3.3.

Capacity Ratio Rating	
Capacity Ratio	Rating (In Terms of Risk
Less than 1.0	Good
1 through 1.4	Fair
1.5 through 2.0	Poor
Over 2.0	Very Poor

4.4 APPROXIMATE ANALYTICAL EVALUATION METHOD

A. Earthquake

In this example the critical elements to be analyzed for resisting seismic forces are the wall piers, particularly on the first story and the floor and roof diaphragms. The seismicity of this location is assumed to be a MMI of 9.5. Thus the Z_s factor is 1.25 (from Formula 2 log 5 Z_s = - 1.973 + .375 MMI). Computations for this building were available. These were made based on seismic design criteria of 1961 UBC. Since 1973, UBC criteria [2.5] are somewhat different, particularly for shear wall design. New computations were necessary. However, the original calculations were of assistance.

This building has a complete vertical load-carrying frame with K of 1.0. As the building is two-story, the C value is .10. The base shear as determined from the formula V = ZKCW is therefore V = 1.25 x .1 x W, where W is the total dead load.

The concrete shear walls are assumed to resist 100% of the lateral forces. The concrete joist systems of the second floor and roof act as horizontal diaphragms to distribute lateral forces to these shear walls.

The dead loads of floors, roofs and walls are computed and a loading diagram is made for each level in each direction and the reactions are computed. See Computation Sheets E2 and E10. The centers of mass for the two levels are then computed.

Next the relative stiffnesses of the various shear walls are obtained, see Computation Sheet E5. It is convenient to use Wall Analysis forms for this. Deflections are read from the chart given in figure 3.11. Walls A, B. C. and D as shown on the DC form are listed in the first column. The next column lists the piers in each wall. In this example, Walls B and D are alike in both stories. The terms "h" and "d" refer to the clear height and width of the piers. The term "Δ" is the deflection of a pier under a load of 1,000,000 pounds and is read from the chart. "K" in this case is the stiffness factor which is the recriprocal of the deflection.

Since all the walls have the same concrete strength and only relative stiffnesses are in the analysis, the modulus of elasticity of 3,000,000 psi as used in the chart may be used in the analysis.

The stiffness of each pier in each wall is combined to obtain the total wall stiffness. This simplifies the computation of the center of resistance. These centers are shown on the loading diagram computation sheets (E-2 and E-10 in the manner shown on Sheets E3 and E4).

The total horizontal force is distributed in proportion to the relative stiffness of the walls. Because of this method of proportioning, the center of mass does not coincide with the center of rigidity. This results in eccentricity thereby creating torsion. The code requires an arbitrary or "accidental" torsion considered in the analysis. These torsional increments are computed in tables on Computation Sheet E18. A legend of terms in these tables is given on Sheet E19. Either direct or accidental torsional moments add to the direct loads computed on the basis of relative stiffnesses alone. The "Factored Design Load" uses a 1.4 multiplier applied to the "Design Load." This 1.4 factor is taken from the Tri-Service Manual [3.1] from Section 2609(d) of the 1973 UBC [2.5] rounded off to the nearest tenth. It is this Factored Design Load that is used in analyzing the individual piers by the Strength Method.

In this example all of the wall piers are potential critical elements and require a specific determination of stresses to determine which is the most critical element. Since these wall piers are non load-bearing, the effect of vertical loads are not considered in the analysis for earthquake forces to the wall. The ratios f_e/f_a are then computed. These ratios show the relative compliance or non-compliance and the most critical f_e/f_a ratios are noted on Form AMA-1. A typical wall is also checked for earthquake forces normal to the wall. This is shown on Computation Sheet E20. The diaphragm shears are noted on the loading diagram sheets. The unit shears and chord stress ratios are then computed on Sheets E9 and E16.

In filling out Form AMB-2, some computations would normally be needed. For this example, some of the items are indicated with critical stress ratios of greater than 1. In the case of "Partitions Other than on Corridors" or "Stair Enclosures" the metal stud and plaster walls with 4 ft metal studs at 16in on center are adequate to span the comparatively low story or ceiling heights in this building and no computations were made.

The only "Exterior Appendage" is the narrow concrete canopy. Unless the earthquake had a vertical component in excess of 1g, this would not fail No computations are made to verify this.

The wall caldding is a thin precast concrete slab used as a form or is thin granite or tile veneer anchored by adhesives. The bond is considered to be good. No computations are required for this item in this case.

FACILITY NO. R.C. BUILDING   FORM AMA-1

APPROXIMATE ANALYTICAL METHOD
STRUCTURAL SYSTEMS - EARTHQUAKE RATING

BUILDING DESIGNATION:

Type of Frame	Type of Diaphragm	Modified Mercalli Intensity	Z_s	Z_c	Critical Elements		Critical Stress Ratio (f_e/f_a)
					Type	Location	
D & F	REIN-FORCED CONCRETE	9.5	1.25	1.0	SHEAR WALL	2ND STORY CORNER PIERS (SHT. E9)	1.32
						1ST STORY B, D & A WALLS ALL PIERS (SHT. E-15)	2.96

TYPE

A Steel Moment Resistant Frames
B Steel Frames - Vertical Load Carrying Only
C Concrete Moment Resistant Frames
D Concrete Frames - Vertical Load Carrying Only
E Masonry Shear Walls - Unreinforced
F Masonry or Concrete Shear Walls - Reinforced
G Combination - Unreinforced Shear Walls and Moments Resistant Frames
H Combination - Reinforced Shear Walls and Moment Resistant Frames
J Braced Frames
K Wood Frame Buildings, Walls Sheathed or Plastered
L Wood Frame Buildings, Walls Without Wood Sheathing or Plaster
M Other

Z_s = Zone factor determined for site from Modified Mercalli Intensity.

Z_c = Zone factor from Code.

NOTE: For rating of Structural Systems, use Form AME.

FACILITY NO. R.C. BUILDING

APPROXIMATE ANALYTICAL METHOD
EXIT CORRIDOR AND STAIR ENCLOSURE WALLS - EARTHQUAKE RATING

Type of Wall	Reinforcement		Anchorage				Critical Stress Rating f_e/f_a	Rating*
	Present	Not Present	Mortar Only	Dowels	Screws or Bolts	Other		
Brick		✓						
Brick		✓						
Concrete Block		✓						
Concrete Block		✓						
Reinforced Concrete	✓						1.02 (PIER 3 SHT. E17)	FAIR
Tilt-up or Precast Concrete		✓						
Steel Studs & Plaster	✓				✓		> 1.0	GOOD
Wood Studs & Plaster		✓						
Hollow Tile		✓						
Hollow Tile & Plaster		✓						

*Obtained from Form AME

FORM AMB-1

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - EARTHQUAKE RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING*
Partitions Other Than on Corridors or Stair Enclosures	< 1.0	GOOD
Exterior Appendages and Wall Cladding	< 1.0	GOOD
Ceiling	NOT LATERALLY BRACED	POOR
Light Fixtures	RECESSED INTO UNBRACED CEIL'G	POOR

*See Form AME - Rating of Critical Stress Ratios.

DESIGN CRITERIA

LOAD CRITERIA

ROOF

5 PLY ROOFING + GRAVEL	= 7.0 p.s.f.
JOIST	= 72.0
BEAMS	= 9.0
CEILING	= 10.0
PARTITION	= 10.0
	108.0 p.s.f.

2ND FLOOR

2½" LIGHT WEIGHT FILL	= 23.0 p.s.f.
JOIST	= 72.0
BEAMS	= 10.0
CEILING	= 10.0
PARTITION	= 20.0
	135.0 p.s.f.

CONCRETE WALLS = 150 p.c.f.
2½" PRECAST CONCRETE VENEER = 31.25 p.s.f.

ROOF LIVE LOAD = 20.0 p.s.f.
FLOOR LIVE LOAD = 100.0 p.s.f.

CHECK LATERAL LOADS FOR 1973 UNIFORM BUILDING CODE

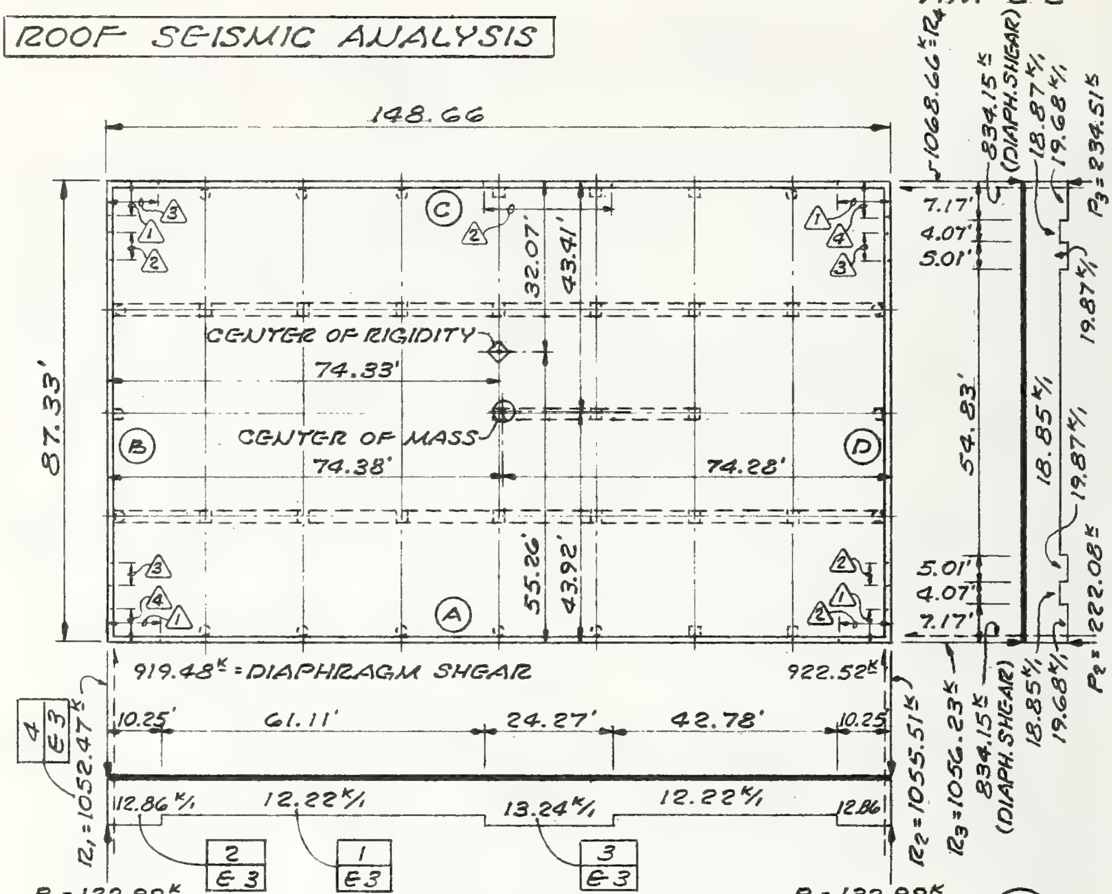
$V = ZKCW = 1.25 \times 1.0 \times 0.1\, W = 0.125\, W$
$Z = Z_S = 1.25$
$K = 1.0$
$C = 0.1$

(SEISMIC FORCE ON ROOF) $F_R = .125\, W_R$
(SEISMIC FORCE ON 2ND FLOOR) $F_2 = .125\, W_2$
W_R = 100 % WEIGHT OF ROOF
W_2 = 100 % WEIGHT OF 2ND FLOOR
$V_2 = .125\ (W_R + W_2)$

DESIGN STRESS CRITERIA (FROM THE PLANS & SPECIFICATIONS)

CONCRETE f'_c = 2500 p.s.i.
REINFORCING STEEL f_y = 40,000 p.s.i.
ALLOWABLE SOIL PRESSURE = 1800 p.s.f. (DEAD + LIVE)

ROOF SEISMIC ANALYSIS



$R_3 + R_4 = 1056.23 + 1068.66 = \underline{W_R = 2125^K}$

LOADS FOR ROOF DIAPHRAGM

PIERS NUMBERED △ ARE IN WALL BELOW

SPANDREL + 2½" PRECAST CONCRETE VENEER

$3.75 \times 1.65 \times 150$ p.c.f. = 928 p.l.f.

CONCRETE CANOPY

$1.69 \times 0.375 \times 150$ p.c.f. = 95 p.l.f.

10" WALL + 2½" PRECAST VENEER

$1.05 \times 3.25 \times 150 = 512$ p.l.f.

PARAPET

$3.5 \times 0.71 \times 150 = 37.3$ p.l.f.

WALL "B" OR "D"

$$P_1 = (.373 + .928)\,87.33 + (.095 \times 72.79) + (.512 \times 24.35) = 132.99^K$$

ROOF SEISMIC ANALYSIS

LOADS FOR ROOF DIAPHRAGM (CONT.)

WALL "A"

$P_2 = (.373 + .928)\,148.66 + (.095 \times 128.17) + (.512 \times 20.5) = 222.08^K$

WALL "C"

$P_3 = (.373 + .928)\,148.66 + (.095 \times 128.17) + (.512 \times 44.71) = 234.51^K$

CONCRETE COLUMNS + BRIDGING		= 670.0 p.l.f.	
ROOF LOAD	= 108 × 87.33	= 9431.6 p.l.f.	
SPANDREL	2 × 928	= 1856.0	
CANOPY	2 × 95	= 190.0	
PARAPET	2 × 37.3	= 74.6	
		12222.2 p.l.f.	1 / E3

EXTERIOR ½ BAYS COLS. + BRIDGING	= 480 p.l.f.	
ROOF	= 9431.6	
SPANDREL	= 1856.0	
PARAPET	= 74.6	
WALL = 2 × 512	= 1024.0	
	12866.2 p.l.f.	2 / E3
CENTER PORTION	= 12222	
WALL = 2 × 512	= 1024	
	13246 p.l.f.	3 / E3

DIAPHRAGM SHEAR = REACTION OF LOAD TO DIAPH. = 919.48

WEIGHT OF WALL B TRIBUTARY TO ROOF = $P_1 = 132.99$

REACTION OF WEIGHT AT WALL B = $R_1 = 1052.47$

4 / E3

DETERMINE CENTER OF RIGIDITY (C.R.) AND CENTER OF MASS (C.M.) FOR NORTH-SOUTH SEISMIC

WALLS "B" AND "D" ARE SIMILAR ∴ (C.R.) IS IN CENTER

148.66 ÷ 2 = 74.33 ft. FROM EXTERIOR OF WALL "B" OR "D"

(C.M.) = 1052.47	×	.625	657.79
1055.51	×	147.92	= 156133.76
2107.98			156791.55

$(C.M.) = \frac{156\,791.55}{2107.98} = 74.38'$ FROM EXTERIOR OF WALL "B"

ROOF SEISMIC ANALYSIS

DETERMINE CENTER OF RIGIDITY (C.R.) AND CENTER OF MASS (C.M.) FOR EAST - WEST SEISMIC

WALL "A" RIGIDITY K = 34.25 SHT. E5
WALL "C" RIGIDITY K = 59.52 SHT. E5

$$(C.R.) = \begin{array}{l} 34.25 \times .625 = 21.42 \\ \underline{59.52} \times 86.71 = \underline{5160.98} \\ 93.77 \qquad\qquad\quad 5182.40 \end{array}$$

$$(C.R.) = \frac{5182.40}{93.77} = 55.26' \text{ FROM EXTERIOR OF WALL "A"}$$

$$(C.M.) = \begin{array}{l} 1056.23 \times .625 = 660.14 \\ \underline{1068.66} \times 86.71 = \underline{92663.51} \\ 2124.89 \qquad\qquad\quad 93323.65 \end{array}$$

$$(C.M.) = \frac{93323.65}{2124.89} = 43.92' \text{ FROM EXTERIOR OF WALL "A"}$$

SEISMIC FORCE ON ROOF

$F_R = .125\ W_R$
$= .125 \times 2125 = 265.63$ KIPS

WALL ANALYSIS - SEISMIC

WALL	PIER	h*	d	h/d	Δ	K	WALL K	H TO WALL	H TO PIER	M	A_s	V_u	REMARKS
2ND STORY WALLS								***					
B & D	1CF **	7.0	7.0	1.0	.0875	11.42		197.7	67.7	237	1.28	237	ALL PIERS
(EAST	2RF	7.0	5.0	1.40	.190	5.26			31.2	109	0.865	153	HAVE 2-#7
&	3RF	7.0	5.0	1.40	.190	5.26			31.2	109	0.865	153	JAMB BARS
WEST)	4CF	7.0	7.0	1.0	.0875	11.42			67.7	237	1.28	237	= 1.20 □"
						33.36							
	(FOR PIER LOCATION SEE PLAN SHEET E2)												WALLS HAVE #4 @ 20" o.c.
	WALL	14	86.6	0.16	.014	(Δ SOLID WALL)							B.W. B.F.
	BAND @ WINDOW	7.0	86.6	0.08	.007	(Δ BAND WINDOW HEIGHT)							∴ ALLOWABLE
	$\Delta\ 1,2,3,4 = \frac{1}{33.36} = .03$ (Δ PIERS 1,2,3,4)												SHEAR V_u = 180 p.s.i.
Δ	WALL = .014 - .007 + .03 = .037 (Δ WALL WITH WINDOWS OUT)												
			$K\ WALL = \frac{1}{.037} = \underline{\underline{27.03}}$										
A	1CF	7.0	10.25	0.68	.053	18.87		152.7	76.4	267.4	0.99	182.7	BOTH PIERS
(NORTH)	2CF	7.0	10.25	0.68	.053	18.87			76.4	267.4	0.99	182.7	HAVE 2 #7
						37.74							JAMB BARS = 1.20 SQ. IN.
	WALL	14.0	148.25	.094	.0065	(Δ SOLID WALL)							FOR M, A_s AND
	BAND @ WINDOW	7.0	148.25	.047	.0033	(Δ BAND WINDOW HEIGHT)							V_u SEE SHEETS E6
	$\Delta 1,2 = \frac{1}{37.74} = .026$ (Δ PIERS 1, 2)												AND E7
Δ	WALL = .0065 - .0033 + 026 = .0292												
				$K\ WALL = \frac{1}{.0292} = \underline{\underline{34.25}}$									
C	1CF	7.0	10.25	0.68	.053	18.87		248.2	63.8	223	.829	152.6	ALL PIERS
	2RC	7.0	23.8	0.29	.028	35.71			120.7	844.9	1.0	124.6	HAVE 2-#6
	3CF	7.0	10.25	0.68	.053	18.87			63.8	223	.829	152.6	= .885 SQ. IN.
						73.45							
	$\Delta 1,2,3 = \frac{1}{73.45} = .0136$												
Δ	WALL = .0065 - .0033 + .0136 = .0168												
			$K\ WALL = \frac{1}{.0168} = \underline{\underline{59.52}}$										

* h = HEIGHT IN FEET
d = DEPTH IN FEET (LENGTH)
Δ = RELATIVE DEFLECTION FROM CHART 6-3-1 TRI SERVICE MANUAL
K = STIFFNESS FACTOR
H = HORIZONTAL FORCE IN KIPS
M = MOMENT IN FOOT KIPS
A_s = AREA OF STEEL IN SQ. INCHES
V = UNIT SHEAR IN LBS. PER SQ. INCH

** CF = CORNER PIER FIXED
RF = RECTANGULAR PIER FIXED
RC = RECTANGULAR PIER CANTILEVER INDICATING THE CURVE USED ON PLATE 6-3-1 OF TRI SERVICE MANUAL

*** H TO WALL IS FACTORED DESIGN LOAD FROM SHEET AM-E18

ROOF SEISMIC ANALYSIS

CHECK WALL PIERS 2ND STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR

WALL "B" & "D"

PIER 1 & 4

2 #7 EXISTING REINFORCEMENT AT JAMBS = 1.20 SQ. IN (FROM PLAN)

$$q = \frac{A_s f_y}{b d f'_c} = \frac{1.2 \times 40000}{10 \times 81 \times 2500} = .0237$$

$$a_u = \frac{\phi f_y (1 - .59q)}{12,000} = \frac{.9 \times 40000 (1 - .59 \times .0237}{12000} = 2.96 \quad \left(\begin{matrix}ACI \\ SP\ No.17\end{matrix}\right)$$

$$M = \frac{67.7 \times 7}{2} = 237^{1K}$$

$$A_s = \frac{237}{2.96 \times 81} = 0.99^{\square''} \times 1.33 (ACI\ 10.5.1) = 1.28^{\square''}$$

STRESS RATIO $\frac{f_e}{f_a} = \frac{1.28}{1.20} = 1.067$ (FLEXURAL TENSION)

SHEAR

$$v_u = \frac{V_u}{\phi h d} = \frac{2 \times 67700}{.85 \times 10 (84 \times .8} = 237\ p.s.i.$$ (FOR V_u USE 2.8 E UBC 2627(a))

$$v_c = 2\sqrt{f'_c} \quad (11.4.1\ ACI\ 318\text{-}71)$$

$$v_c = 2\sqrt{2500} = 100\ p.s.i.$$

WALLS REINFORCED WITH #4 @ 20" o.c. BOTH WAYS BOTH FACES

$$A_v = \frac{(v_u - v_c) b_w S}{f_y} \quad (11.6.1\ ACI\ 318\text{-}71)$$

$$v_u = \frac{A_v f_y}{b_w S} + v_c$$

$$v_u = \frac{.40 \times 40000}{10 \times 20} + 100$$

v_u = 180 p.s.i. ALLOWABLE WITH EXISTING REINFORCING

STRESS RATIO $\frac{f_e}{f_a} = \frac{237}{180} = 1.32$ (SHEAR)

CHECK COMPRESSIVE STRESS IN THE CONCRETE

$$f_c = .85 f'_c = .85 \times 2300 = 2125\ p.s.i.$$

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{1.2 \times 40,000}{2125 \times 10} = 2.259\ IN.$$

$$j_u d = \left(81 - \frac{2.259}{2}\right) = 79.87''$$

ROOF SEISMIC ANALYSIS

CHECK WALL PIERS 2ND STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR (CONT.)

WALL "B" & "D" (CONT.)

CHECK COMPRESSIVE STRESS IN THE CONCRETE (CONT.)

$C = 2.259 \times 2125 \times 10 = 48000$ LB.

$$M_u = \frac{.9 \times 79.87 \times 48}{12} = 287.53 \text{ FT. KIPS}$$

$$\text{STRESS RATIO} = \frac{237}{287.53} = 0.82 \text{ NOT CRITICAL}$$

FOR THE COMPRESSION STRESS RATIO THE EFFECT OF COMPRESSIVE STEEL WAS NOT CONSIDERED. IN MOST CASES THE COMPRESSIVE STRESSES IN PIERS ARE NOT CRITICAL AND IT IS NOT CHECKED IN THE REST OF THIS EXAMPLE.

THE OVERALL BUILDING PROPERTIES ARE NEGLECTED FOR DETERMINING REINFORCEMENT REQUIREMENTS OF INDIVIDUAL PIERS BECAUSE FOR LOW BUILDINGS OF THIS TYPE IT DOES NOT CHANGE THE REINFORCEMENT REQUIREMENTS.

PIER 2 & 3

$$M = \frac{31.2 \times 7}{2} = 109^{\text{IK}} \qquad a_u = 2.94 \quad 2\text{-}\#7 \text{ JAMB BARS} = 1.20$$

$$A_s = \frac{109}{2.94 \times 57} = 0.65 \text{ SQ. IN.} \times 1.33 = 0.87 \text{ SQ. IN}$$

$$\text{STRESS RATIO} = \frac{0.87}{1.20} = 0.73 \text{ (FLEXURAL TENSION)}$$

$$v_u = \frac{2 \times 31200}{.85 \times 10 (60 \times .8)} = 152.9 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{0.87}{1.20} = 0.85 \text{ (SHEAR)}$$

WALL "A"

PIER 1 & 2 (FOR LOCATION SEE PLAN SHEET AM-E2)

2-#7 JAMB BARS EXISTING = 1.20 SQ. IN. $a_u = 2.97$

$$M = \frac{76.4 \times 7}{2} = 267.4^{\text{IK}}$$

$$A_s = \frac{267.4}{2.97 \times 120} = 0.75 \times 1.33 = 0.99 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{0.99}{1.20} = 0.83 \text{ (FLEXURAL TENSION)}$$

ROOF SEISMIC ANALYSIS

CHECK WALL PIERS 2ND STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR (CONT.)

WALL "A" (CONT.)

$$V_u = \frac{2 \times 76400}{.85 \times 10(123 \times .8} = 182.7 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{182.7}{180.0} = 1.02 \text{ (SHEAR)}$$

WALL "C"

PIER 1 ¢ 3

2-#6 JAMB BARS EXISTING = 0.88 SQ. IN. $a_u = 2.98$

$M = 223^{1K}$

$$A_S = \frac{223}{2.98 \times 120} = .624 \times 1.33 = 0.83 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{0.83}{0.88} = 0.94 \text{ (FLEXURAL TENSION)}$$

$$V_u = \frac{2 \times 63800}{.85 \times 10(123 \times .8)} = 152.6 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{152.6}{180} = 0.85 \text{ (SHEAR)}$$

PIER 2

2-#6 JAMB BARS EXISTING = 0.88 SQ.IN. $a_u = 2.99$

$M = 120.7 \times \frac{7}{1.6} = 528^{1K}$ (CONSIDER PIER PARTIALLY FIXED)

$$A_S = \frac{528}{2.99 \times 282} = 0.626 \times 1.33 = 0.83 \text{ SQ.IN.}$$

$$\text{STRESS RATIO} = \frac{0.83}{0.88} = 0.94 \text{ (FLEXURAL TENSION)}$$

$$V_u = \frac{2 \times 120{,}700}{.85 \times 10(285 \times .8)} = 124.6 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{124.6}{180} = 0.69 \text{ (SHEAR)}$$

ROOF SEISMIC ANALYSIS

CHECK ROOF DIAPHRAGM SHEAR
($7\frac{1}{2}'' \times 16''$ JOIST + $2\frac{1}{2}''$ SLAB)

$$922.5^{K} \ (100\% \ G) \times \frac{265.63}{2125} = 115.3^{K} \ (\text{SEISMIC})$$

$$v_u = \frac{1.4 \times 115\,300}{.85 \times 2.5 \ (1049 \times .8} = 90.5 \ p.s.i.$$

$$\text{STRESS RATIO} = \frac{90.5}{100} = 0.91$$

CHORD STRESS

$$M = 922.52 \times 73.27 = 67593$$
$$\begin{array}{r} -35565 \\ \hline 32028 \end{array} \times \frac{265.63}{2125} = 4003^{\prime K}$$

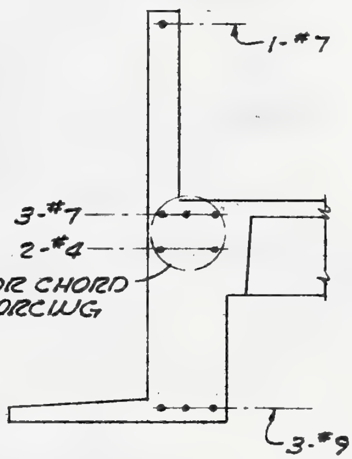
$$-(12.86 \times 10.25) \times 68.5 = 8983.5$$
$$-(12.22 \times 42.78) \times 45.66 = 23869.7$$
$$-13.24 \times \frac{(20.24)^2}{2} = \underline{2711.9}$$
$$35565.1$$

$$T = \frac{4004 \times 1.4}{86.5} = 64.79^{K}$$

$$A_s = \frac{64.79}{.9 \times 40} = 1.79 \ \text{SQ. IN.}$$

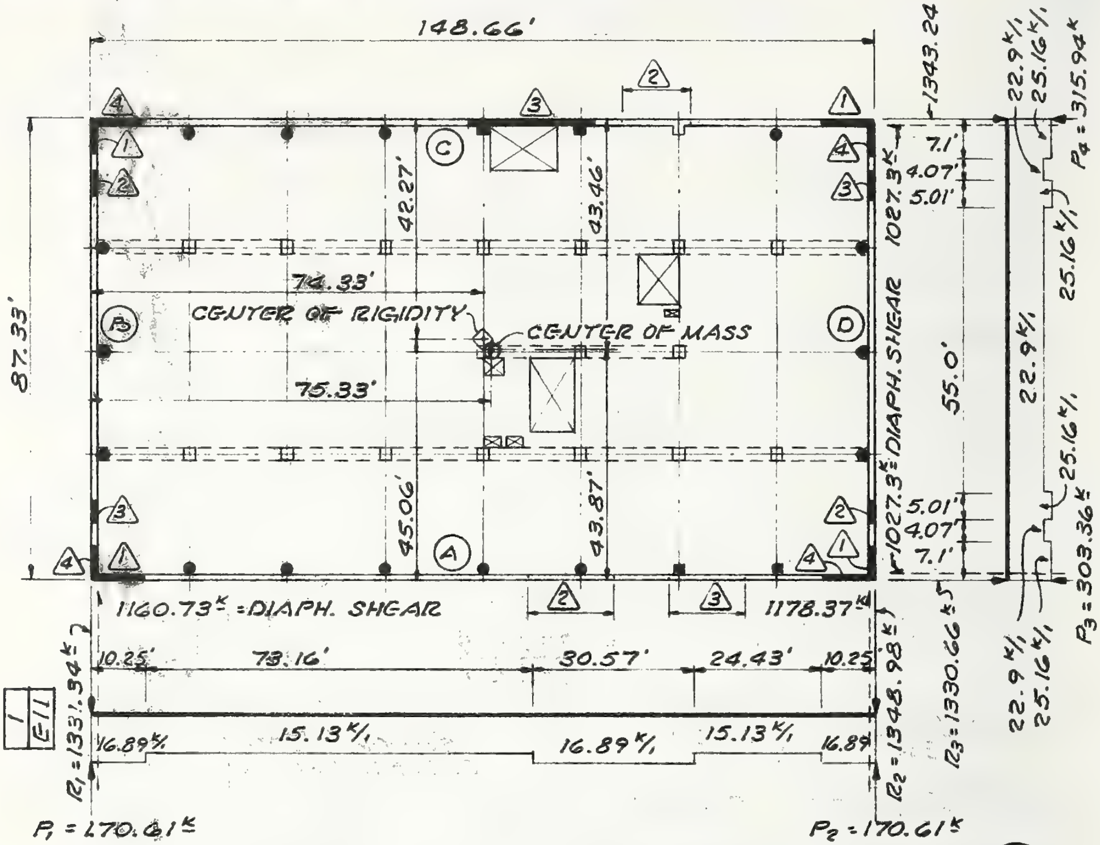
$$\text{STRESS RATIO} = \frac{1.79}{2.20} = 0.81$$

3-#7 = 1.80
2-#4 = $\underline{0.40}$
2.20 □''



AM-E10

SECOND FLOOR SEISMIC ANALYSIS



$R_1 + R_2 = 1331.34 + 1348.98 = \underline{W_2 = 2680^k}$

LOADS FOR 2ND FLOOR DIAPHRAGM

PIERS NUMBERED △ ARE IN WALL BELOW

SPANDREL + 2½" PRECAST VENEER

$3.75 \times 1.65 \times 150 = 928$ p.l.f.

CONCRETE CANOPY

(1) $1.69 \times .375 \times 150 = 95$ p.l.f.
(2) $9 \times 0.45 \times 150 = 610$ p.l.f.

$\therefore$ AVG $= \dfrac{95+60}{2} = 353$ p.l.f.

7' WINDOW + 3' WALL (8½")

$(7 \times 10) + (3 \times .71 \times 150 = 390$ p.l.f.

10" WALL + 2½" PRECAST VENEER

$1.05 \times 10.25 \times 150 = 1615$ p.l.f.

SECOND FLOOR SEISMIC ANALYSIS

LOADS FOR 2ND FLOOR DIAPHRAGM (CONT.)

WALLS B & D

$P_1 = P_2 = (.928 \times 87.33) + (1.615 \times 24.22) + (.39 \times 63.11) + (.353 \times 73.2)$
$= 170.61$ KIPS

WALL A

$P_3 = (.928 \times 148.66) + (1.615 \times 50.76) + (.39 \times 97.91) + (.353 \times 128.16)$
$= 303.36$ KIPS

WALL C

$P_4 = (.928 \times 148.66) + (1.615 \times 56.8) + (.39 \times 105.16) + (.353 \times 128.16)$
$= 315.94$ KIPS

ROOF LOAD	= 135 × 87.33	= 11789.6
SPANDREL	= 2 × 928	= 1856.0
CANOPY	= 2 × 353	= 706.0
WINDOW + 3' WALL	2 × 390	= 780.0
		15131.6 p.l.f.

DIAPHRAGM SHEAR = REACTION OF LOADS TO DIAPHRAGM = 1160.73
WEIGHT OF WALL B TRIBUTARY TO 2ND FLOOR P_1 = 170.61
REACTION OF WEIGHT IN KIPS AT WALL B = R_1 = 1331.34

$\frac{1}{E11}$

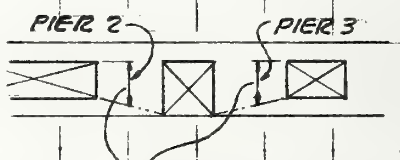
SEISMIC FORCE ON 2ND FLOOR

$F_2 = .125\ W_2$
$= .125 \times 2680 = 335$ KIPS

$V_2 = .125\ (W_R + W_2)$
$= .125\ (2125 + 2680) = 600.6$ KIPS

WALL ANALYSIS - SEISMIC

WALL	PIER	h	d	h/d	Δ	K	WALL K	H TO WALL	H TO PIER	M	A_s	V_u	REMARKS
1ST STORY WALLS													
B & D (EAST & WEST)	1 CF	7.0	7.0	1.0	.0875	11.42		443.8	151.9	531.7	3.0	531.9	ALL PIERS HAVE 2-#7 JAMB BARS = 1.20 □"
	2 RF	7.0	5.0	1.40	.190	5.26			70.0	245.0	1.99	343.1	
	3 RF	7.0	5.0	1.40	.190	5.26			70.0	245.0	1.99	343.1	
	4 CF	7.0	7.0	1.0	.0875	11.42			151.9	531.7	3.0	531.9	WALLS HAVE #4@20"o.c. B.W. B.F. ∴ ALLOWABLE SHEAR v_u = 180 p.s.i.
						33.36	27.03						
A (NORTH)	1 CF	7.0	10.0	0.70	.054	18.52		439.4	106.7	373.5	1.43	261.5	ALL PIERS HAVE 2-#7 JAMB BARS = 1.20 □"
	2 RF	8.5	15.33	.55	.050	20.00			115.2	489.6	1.21	185	
	3 RF	8.5	14.83	.57	.052	19.23			110.8	470.9	1.21	184	
	4 CF	7.0	10.0	0.70	.054	18.52			106.7	373.5	1.43	261.5	
						76.27							
	WALL	14	148.66	.094	.008								
	BAND @ WINDOW	8.5	148.66	.057	.005								



USE AVE. PIER HEIGHT 8.5' TO SIMPLIFY FOR APPROX. K

$\Delta\ (1\ TO\ 4) = \frac{1}{76.27} = .013$

Δ WALL $.008 - .005 + .013 = .016$

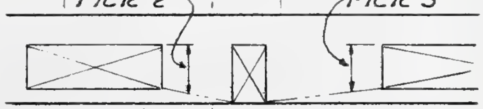
$K\ WALL = \frac{1}{.016} = \underline{\underline{62.50}}$

NOTE: FOR SYMBOLS SEE AM-E5

WALL ANALYSIS - SEISMIC

WALL	PIER	h	d	h/d	Δ	K	WALL K	H TO WALL	H TO PIER	M	A_s	V_u	REMARKS
1ST STORY WALLS													
C	1	7.0	10.0	0.70	.054	18.52		466.6	101.7	356.0	1.36	249.3	2-#7 = 1.20
(SOUTH)	2	8.5	13.25	0.64	.060	16.67			91.6	389.3	1.10	169.4	2-#7
	3	8.5	22.92	0.37	.032	31.25			171.6	729.3	1.19	183.5	2-#9 = 2.0
	4	7.0	10.0	0.70	.054	18.52			101.7	356.0	1.36	249.3	2-#7 = 1.20
						84.96							MAX. V_u = 180 p.s.i.
	WALL	14	148.66	.094	.008								
	BAND @ WINDOW	8.5	148.66	.057	.005								

$\Delta (1 \text{ TO } 4) = \frac{1}{84.96} = .012$



USE AVG. PIER HEIGH 8.5' TO SIMPLIFY FOR APPROX. K

Δ WALL $.008 - .005 + .012 = .015$

K WALL $= \frac{1}{.015} = \underline{\underline{66.67}}$

NOTE: FOR SYMBOLS SEE AM-E5

SECOND FLOOR SEISMIC ANALYSIS

CHECK WALL PIERS 1ST STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR

FOR TYPICAL WALL REINFORCEMENT #4@20" o.c. B.W. B.F.
ALLOWABLE v_u = 180 p.s.i. (SHEET AM-E6)

WALL "B"

PIER 1 & 4

2-#10 JAMB BARS EXISTING = 2.54 SQ. IN. $a_u = 2.91$

$$M = \frac{151.9 \times 7}{2} = 531.7^{\text{IK}}$$

$$A_s = \frac{531.7}{2.91 \times 81} = 2.26 \times 1.33 = 3.0 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{f_e}{f_a} = \frac{3.0}{2.54} = 1.18 \text{ (FLEXURAL TENSION)}$$

$$v_u = \frac{2 \times 151\,900}{.85 \times 10 \times (84 \times .8)} = 531.9 \text{ (FOR } V_u \text{ USE 2.8E UBC 2627(a))}$$

$$\text{STRESS RATIO} = \frac{531.9}{180} = 2.96 \text{ (SHEAR)}$$

PIER 2 & 3

2-#10 JAMB BARS EXISTING = 2.54 SQ. IN. $a_u = 2.87$

$$M = \frac{70 \times 7}{2} = 245^{\text{IK}}$$

$$A_s = \frac{245}{2.87 \times 57} = 1.50 \times 1.33 = 1.99 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.99}{2.54} = 0.78 \text{ (FLEXURAL TENSION)}$$

$$v_u = \frac{2 \times 70\,000}{.85 \times 10 \times (60 \times .8)} = 343.1 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{343.1}{180} = 1.91 \text{ (SHEAR)}$$

WALL "A" (PIER 1 & 4)

2-#7 JAMB BARS EXISTING = 1.20 SQ. IN. $a_u = 2.97$

$$M = \frac{106.7 \times 7}{2} = 373.5$$

$$A_s = \frac{373.5}{2.97 \times 117} = 1.07 \times 1.33 = 1.43 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.43}{1.20} = 1.19 \text{ (FLEXURAL TENSION)}$$

SECOND FLOOR SEISMIC ANALYSIS

CHECK WALL PIERS 1ST STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR (CONT.)

WALL "A" (CONT.)

$$v_u = \frac{2 \times 106\,700}{.85 \times 10\,(120 \times .8)} = 261.5 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{261.5}{180} = 1.45 \text{ (SHEAR)}$$

PIER 2

2-#7 JAMB BARS EXISTING = 1.20 SQ. IN. $a_u = 2.98$

$$M = \frac{115.2 \times 8.5}{2} = 489.6^{\text{IK}}$$

$$A_S = \frac{489.6}{2.98 \times 180} = 0.91 \times 1.33 = 1.21 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.21}{1.20} = 1.00 \text{ (FLEXURAL TENSION)}$$

$$v_u = \frac{2 \times 115\,200}{.85 \times 10 \times (183 \times .8)} = 185 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{185}{180} = 1.23 \text{ (SHEAR)}$$

PIER 3

$$M = \frac{110.8 \times 8.5}{2} = 470.9^{\text{IK}}$$

$$A_S = \frac{470.9}{2.98 \times 174} = 0.91 \text{ SQ. IN.} \times 1.33 = 1.21 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.21}{1.20} = 1.00$$

$$v_u = \frac{2 \times 110800}{.85 \times 10 \times (177 \times .8)} = 184 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{184}{180} = 1.02$$

WALL "C"

PIER 1 & 4

2-#7 JAMB BARS EXISTING = 1.20 SQ. IN. $a_u = 2.97$

$$M = \frac{101.7 \times 7}{2} = 356.0^{\text{IK}}$$

$$A_S = \frac{356}{2.97 \times 117} = 1.02 \times 1.33 = 1.36 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.36}{1.20} = 1.13 \text{ (FLEXURAL TENSION)}$$

SECOND FLOOR SEISMIC ANALYSIS

CHECK WALL PIERS 1ST STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR (CONT.)

WALL "C" (CONT.)

$$v_u = \frac{2 \times 101700}{.85 \times 10 \times (120 \times .8)} = 249.3 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{249.3}{180} = 1.40 \text{ (SHEAR)}$$

PIER 2

2-#7 JAMB BARS = 1.20 SQ. IN.

$$M = \frac{91.6 \times 8.5}{2} = 389.3$$

$$A_s = \frac{389.3}{2.98 \times 156} = 0.84 \times 1.33 = 1.1 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.1}{1.2} = 0.92$$

$$v_u = \frac{2 \times 91600}{.85 \times 10 \times (159 \times .8)} = 169.4 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{169.4}{180} = 0.94$$

PIER 3

2-#9 JAMB BARS EXISTING = 2.0 SQ. IN. $a_u = 2.98$

$$M = \frac{171.6 \times 8.5}{2} = 729.3^{\text{'K}}$$

$$A_s = \frac{729.3}{2.98 \times 272} = 0.90 \times 1.33 = 1.19 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.19}{2.0} = 0.60$$

$$v_u = \frac{2 \times 171600}{.85 \times 10 \times (275 \times .8)} = 183.5 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{f_e}{f_a} = \frac{183.5}{180} = 1.02$$

CHECK 2ND FLOOR DIAPHRAGM SHEAR

$F_2 = 335$ KIPS (SHEET AM-E11)

DIAPHRAGM SHEAR (SHEET AM-E10) $= 1178.37 \times \frac{335}{2680} = 147.3$ KIPS

ROOF DIAPHRAGM SHEAR = 90.5 p.s.i. (SHEET AM-E9)

$$v_u = \frac{147.3}{115.3} \times 90.5 = 115.6 \text{ p.s.i.}$$

2½" SLAB REINFORCED WITH 4"x4"/#10x#10 E.W.M.

No. 10 = 0.135 IN. DIAMETER = 0.0021 SQ. IN. AREA

SECOND FLOOR SEISMIC ANALYSIS

CHECK 2ND FLOOR DIAPHRAGM SHEAR (CONT.)

$$v_u = \frac{f_y A_v}{b_w S} + v_c = \frac{64000 \times .0021}{2.5 \times 4} + 100 = 113 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{115.5}{113} = 1.02$$

CHORD STRESS

$$M = 1160.73 \times 75.52 \qquad = 87658.3$$

$$-15.13 \times \frac{(65.77)^2}{2} = 32723.9 \qquad \underline{-44910.7}$$

$$\qquad\qquad\qquad\qquad 42747.6$$

$$-173.12 \times 70.395 = \underline{12186.8}$$

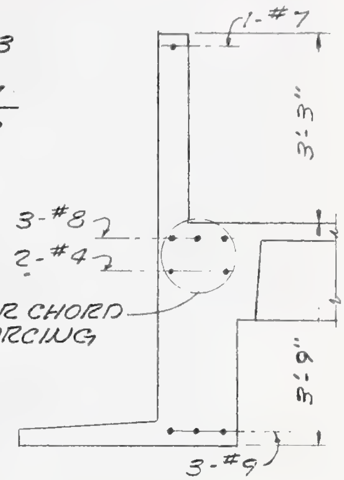
$$44910.7$$

$$\frac{335}{2680} \times 42747.6 = 5343.5^{\prime K}$$

$$T = \frac{5343.5 \times 1.4}{86.5} = 86.5 \text{ KIPS}$$

$$A_S = \frac{86.5}{.9 \times 40} = 2.40 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{2.40}{2.77} = 0.87$$



USE FOR CHORD REINFORCING

CALCULATE K LOADS TO WALLS

2ND STORY

K FROM SHEET AM-E5

F_R FROM SHEET AM-E4 = 265.6 KIPS

K WALL B = 27.03 $\qquad$ K LOAD $= \frac{265.6}{54.06} \times 27.03 = 132.8$ KIPS

$D = \frac{27.03}{54.06}$ $\qquad$ $= 132.8$

K WALL A = 34.25 $\qquad$ K LOAD $= \frac{265.6}{93.77} \times 34.25 = 97.0$

$C = \frac{59.52}{93.77}$ $\qquad$ " $\times 59.52 = 168.6$

1ST STORY

K FROM SHEET AM-E12 & AM-E13

V_2 FROM SHEET AM-E11 = 600.6 KIPS

K WALL B = 27.03 $\qquad$ K LOAD $= \frac{600.6}{54.06} \times 27.03 = 300.3$ KIPS

$D = \frac{27.03}{54.06}$ $\qquad$ " $= 300.3$

K WALL A = 62.50 $\qquad$ K LOAD $= \frac{600.6}{129.17} \times 62.5 = 290.6$

$C = \frac{66.67}{129.17}$ $\qquad$ " $\times 66.67 = 310.0$

SEISMIC ANALYSIS

DETERMINATION OF DESIGN LOADS TO WALLS

(SEE AM-E19 FOR SYMBOLS AND DEFINITION OF TERMS)

2ND STORY (ROOF DIAPHRAGM)

WALL	K	d^2	Kd^2	$\frac{M_T}{\Sigma Kd^2} \times 10^3$	÷ d	S_{N-S}	S_{E-W}	$S_{ACCID.}$	K LOAD	DESIGN LOAD	FACTORED DESIGN LOAD *
B	27.03	5433	146858	.0285 (N-S) -6.45 (E-W) 4.281 ACCIDENTAL	-73.71	-.056	9.46	8.43	132.8	141.2	197.7
D	27.03	5433	146858		73.71	+.056	-9.46	8.43	132.8	141.2	197.7
	54.06										
A	34.25	2985.5	102254		-54.64	-.053	12.07	7.92	97.0	109.1	152.7
C	59.52	1186.8	70638		34.45	+.058	-9.74	8.68	168.6	177.3	248.2
	93.77		Σ=466608								

M_T (N-S) = 265.63 × .05 = +13.28 ^{IK}

M_T (E-W) = 265.63 × -11.34 = -3012.2 ^{IK}

ACCIDENTAL TORSION = 265.63 × .05 × 148.66 = ±1974.4 ^{IK}

* FACTORED DESIGN LOAD = 1.4 (DESIGN LOAD)

1ST STORY (2ND FLOOR DIAPHRAGM)

WALL	K	d^2	Kd^2	$\frac{M_T}{\Sigma Kd^2} \times 10^3$	÷ d	S_{N-S}	S_{E-W}	$S_{ACCID.}$	K LOAD	DESIGN LOAD	FACTORED DESIGN LOAD
B	27.03	5433	146858	.453 (N-S) -1.317 (E-W) ±8.381 ACCIDENTAL	-73.71	-.90	2.62	16.70	300.3	317.0	443.8
D	27.03	5433	146858		73.71	+.90	-2.62	16.70	300.3	317.0	443.8
	54.06										
A	62.50	1974	123377		-44.43	-1.26	3.66	23.27	290.6	313.9	439.4
C	66.67	1734	115598		41.64	+1.26	-3.66	23.27	310.0	333.3	466.6
	129.17		Σ = 532691								

M_T (N-S) = (265.63 × .05) + (335 × .69) = 244.4 ^{IK}

M_T (E-W) = (265.63 × 5.89) + (335 × 5.94) = -3554.5 ^{IK}

ACCIDENTAL TORSION = 600.63 × .05 × 148.66 = ± 4464.5 ^{IK}

SEISMIC ANALYSIS

SYMBOLS (FOR SHEET AM-E18)

K	=	RELATIVE WALL STIFFNESS
d	=	DISTANCE BETWEEN CENTER OF WALL AND CENTER OF RIGIDITY IN FEET.
M_T	=	TORSIONAL MOMENT = STORY SHEAR TIMES DISTANCE BETWEEN CENTER OF MASS AND CENTER OF RIGIDITY (CONSIDERED IN EACH DIRECTION AND FOR ACCIDENTAL TORSION).
S_{N-S}	=	SHEAR TO WALL DUE TO TORSION FROM NORTH-SOUTH SEISMIC.
S_{E-W}	=	SHEAR TO WALL DUE TO TORSION FROM EAST-WEST SEISMIC.
$S_{ACCID.}$	=	SHEAR TO WALL DUE TO TORSION FROM ACCIDENTAL TORSION.
K LOAD	=	LOAD TO WALL BASED ON RELATIVE STIFFNESS
DESIGN LOAD	=	K LOAD PLUS THE GREATER OF ACCIDENTAL TORSION OR TORSION DUE TO LATERIAL LOADS IN THE DIRECTION OF THE WALLS.

WALL ANALYSIS - NORMAL FORCES

EARTHQUAKE

CHECK A PANEL FOR FORCES NORMAL TO WALL. SINCE THE BUILDING HAS A COMPLETE VERTICAL LOAD-CARRYING SPACE FRAME, THE ONLY VERTICAL LOAD IS THE WEIGHT OF THE WALL PLUS PRECAST CONCRETE VENEER WALL PANELS (MOSAI)

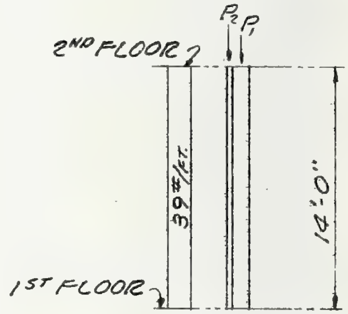
$C_p = 0.20$

$F_p = 2\,C_p\,W_p$

10" CONCRETE WALL $= 124.5\ \#/\square'$

2½" MOSAI $= \underline{31.3\ \#/\square'}$

$155.8\ \#/\square'$



$f'_c = 2500$ p.s.i. $f_y = 40{,}000$ p.s.i. $n = 10$

$V = 0.9D + 1.4E$

$F_p = 1.25 \times .2 \times 155.8 = 38.95\ \#/\square'$

P_1 (WALL) $= 124.5 \times 7 = 871.5\#$

P_2 (MOSAI) $= 31.3 \times 7 = \underline{219.1}$

$1090.6\# = P$

$P_u = .9 \times 1090.6 = 981.5\#$

M (MOSAI) $= 219.1 \times 6.25 = 1369.4''\# \times .9 \qquad = 1232.5$

M (SEISMIC) $= \dfrac{39 \times 14^2}{8} = 956\ \# \times 12 = 11466''\# \times 1.4 = \underline{16052.4}$

$17284.9''\#$

REINFORCING #4 @ 20" o.c. $p = \dfrac{A_s}{bd} = \dfrac{.20}{1.67 \times 12 \times 8.5} = .0012$

$np = 10 \times .0012 = .012 \quad 2/kj = 14.65 \qquad A_s = \dfrac{.20}{1.67} = 0.12\ \square''/'$

p MIN. $= \dfrac{200}{40000} = .005 > .0012 \quad \therefore A_s$ REQ. $= 1.33\,A_s$

$A_s = \dfrac{M_u}{\phi f_s jd} = \dfrac{17285}{.9 \times 40000 \times .875 \times 8.5} = .065\ \square'' \times 1.33 = .086\ \square''$

STRESS RATIO $= \dfrac{.086}{.12} = 0.72$ (FLEXURAL TENSION)

$f_m = \dfrac{M_u}{\phi bd^2}\left(\dfrac{2}{kj}\right) = \dfrac{17285}{.7 \times 12 \times (8.5)^2} \times 14.65 = 417.2$ p.s.i.

$f_a = \dfrac{P}{\phi A} = \dfrac{981.5}{.7 \times 12 \times 10} = 11.7$ p.s.i.

$+\underline{417.2}$

428.9 p.s.i.

STRESS RATIO $= \dfrac{428.9}{2500} = 0.17$ (FLEXURAL COMPRESSION)

B. Wind

In this example, the critical elements to be determined for resisting wind forces are the wall piers and the floor and roof diaphragms. The assumed Basic Wind Speed is 100 mph with Exposure "C." No wind calculations were found. Earthquake calculations had been made and were of assistance, since a ratio of the design base shear for earthquake to total wind forces could be obtained.

The computations shown for this example are limited to the determination of wind forces and the distribution of these forces to the building, determining the critical elements and the critical stress ratio so that a final wind rating can be given.

From 1972 ANSI [3.2], Table 5, Exposure C, an effective velocity pressure, q_F, of 33 psf for a height of 30 feet is obtained. From table 7 the positive pressure coefficient on the windward side is 0.8 and the negative pressure coefficient on the leeward side is 0.5 for the ratio of wall height to least width less than 2.5. The total horizontal wind force on the building therefore is 1.3 times q_F. A suction coefficient of .7 for side walls is used. This is taken from 1972 ANSI [3.2, Paragraph 6.5.3.2.].

A plan of the roof with computed horizontal wind forces and reactions at roof level is shown on Calculation Sheet W2. The loads are determined using as tributary wind area one-half the story height (second floor to roof) plus the parapet. A similar computation is made for forces tributary to the second floor and these wind forces are shown on Sheet W5.

Uplift is computed on the narrow concrete projecting canopies. The coefficient of -1.25 is taken from 1973 UBC, [2.5, Section 2308 (c)]. The uplift is less than the dead load, thus, having all the reinforcing bars in the top is not critical. However, it would not fall off the building because the anchorage of the reinforcing steel would prevent this. This canopy is not a critical element in the evaluation of the building as a whole.

With the wind loads to the building as a whole determined, the shear walls are checked next. In section 4.4A, the relative stiffnesses of these walls have been computed and the total seismic force at each level determined. The ratio of wind forces to the seismic forces is computed. In the second story this ratio is 0.257 in the north-south direction and 0.151 in the east-west direction. Similar ratios are developed for the first story. The shear capacity is determined and compared with factored wind shears.

A typical wall panel had been checked for tornado forces normal to the wall. This is shown on Calculation Sheet AM-T9. Since the wind forces are less than the tornado forces, a calculation for wind was not considered necessary. However, a check of the wind pressure was made of wall corners using a coefficient of -2.0 (1972 ANSI, Paragraph 6.5.3.1) showing that this was less than the tornado pressure.

The Critical Stress Ratio is determined to be 0.26 for the second story corner piers 1 and 4, Walls B and D.

In filling out Form AMC-2 for "Other Life Hazards," some computations would normally be made. In this example the window frame anchorage, according to the architectural details on the original design drawings consists of 3/8 bolts at 2 ft on center. This gives only about 7 sq ft of window per anchor. This is obviously satisfactory so no written calculation was made; however, the Critical Stress Ratio would be less than 1.

The only wall cladding is a thin exposed aggregate precast concrete veneer that was used as a form for the poured concrete. The bond in this case should be adequate. Steel anchors are also used at the floor line however, and the Critical Stress Ratio would be less than 1.

There is a small area of granite facing near the entrance. This is a thin 7/8 in veneer applied with adhesive which is considered adequate. The usual requirement for this type of adhesive is 50 p.s.i. in tension or shear. Since a visual examination revealed no deterioration of this veneer or the veneer joints, the veneer is considered adequately attached to the wall.

Computations were made on the exposed walls and the canopy as previously noted, including the Critical Stress Ratios.

FACILITY NO. R.C. BUILDING

APPROXIMATE ANALYTICAL METHOD
STRUCTURAL SYSTEMS - WIND RATING

BUILDING DESIGNATION:

Exposure A,B,or C	Basic Wind Speed* V_1	Building Height	Effective Velocity Pressure q_F	Design Unit Pressure q_Fx1.4=P or q_Fx1.3=P	Critical Elements: Type	Critical Elements: Location	Critical Stress Ratio f_w/f_a	Basic Wind Speed Capacity $V_2 = V_1\sqrt{f_a/f_w}$
C	100	31'-8¼"	33	1.3 × 33 = 42.9	SHEAR WALL	CORNER PIERS WALLS 8 & 0 (SHT. AM-W5 & W7	.26	196
			22	1.3 × 22 = 28.6		CORNER STRIP ALL WALLS (SHT AM-W9)	.94	

*See ANSI A58.1-72

f_w = Stress resulting from design pressures.
f_a = Allowable Material stress (x 1.33 where applicable)

NOTE: For rating of Structural Systems, use Form AME.

FORM AMC-1

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - WIND RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING
Glass Breakage*	------	COMPLIANCE
Glazing*	------	COMPLIANCE
Window Frame Anchorage	< 1.0	GOOD
Wall Cladding Anchorage	< 1.0	GOOD
Anchorage of Exterior Appendages	-------	
Exposed Walls	< 1.0	GOOD
Canopies and Eaves	.81	GOOD

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE*

TYPE	QUANTITY	DISTANCE
LUMBER YARD	LARGE	400'

*See Instructions for ratings.

CRITICAL STRESS RATIO	RATING
< 1.0	Good
1.0 to 1.5	Fair
> 1.5	Poor

DESIGN CRITERIA

LOAD CRITERIA

ROOF DEAD LOADS

5 PLY ROOFING + GRAVEL	= 7.0 p.s.f.
JOISTS	= 72.0
BEAMS	= 9.0
CEILING	= 10.0
	98.0 p.s.f.

CONCRETE WALLS 150 p.c.f.
2½" PRECAST CONCRETE VENEER = 31.25 p.s.f.

ROOF LIVE LOAD = 20.0 p.s.f.

WIND CRITERIA (ANSI A58.1-1972)

EFFECTIVE VELOCITY PRESSURE q_F FOR BASIC WIND SPEED 100 m.p.h. AT 30 ft ELEVATION FOR EXPOSURE C = 33 p.s.f. (TABLE 5)

EXTERNAL PRESSURE COEFFICIENTS FOR WALLS, C_p

WINDWARD WALL	0.8
LEEWARD WALL	0.5
TOTAL DESIGN WIND LOAD	= 1.3 (TABLE 7)

UPLIFT PRESSURE COEFFICIENT ON ROOF = -0.7 (SECT. 6.5.3.2.1)
WALLS - LOCAL PRESSURE COEFFICIENT = - 2.0 (SECT. 6.5.3.1)

FROM UBC 1973

UPLIFT PRESSURE COEFFICIENT FOR CANOPIES = -1.25 (SECT. 2308(c))

FROM ACI 318-71

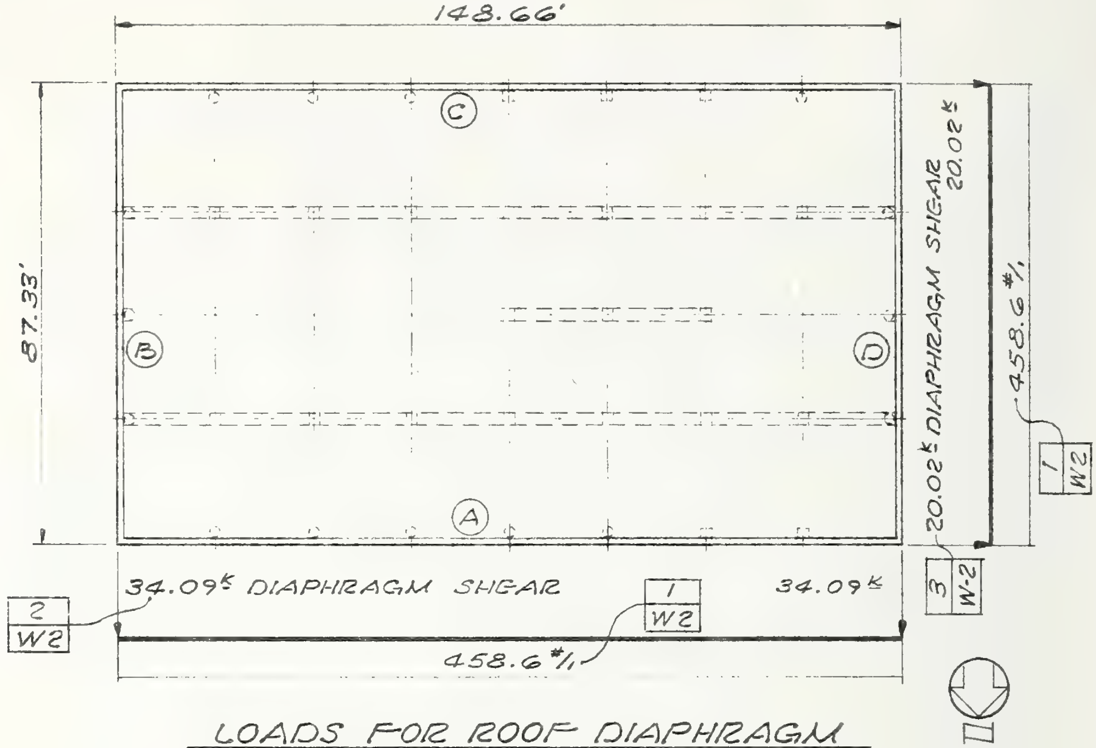
REQUIRED STRENGTH $U = 0.9D + 1.3W$

DESIGN CRITERIA

(FROM THE PLANS AND SPECIFICATIONS)

CONCRETE f'_c = 2500 p.s.i.
REINFORCING STEEL f_y = 40,000 p.s.i.
ALLOWABLE SOIL PRESSURE = 1800 p.s.f. (DEAD + LIVE)

ROOF WIND ANALYSIS



LOADS FOR ROOF DIAPHRAGM

ELEVATION PARAPET = 31'-8¼"
ELEVATION ROOF = 28'-0"
ELEVATION 2ND FLOOR = 14'-0"
BASIC PRESSURE = 33 p.s.f.
PRESSURE COEFFICIENT WINDWARD SIDE = 0.8
PRESSURE COEFFICIENT LEEWARD SIDE = 0.5
1.3

WALL TRIBUTARY TO ROOF

PARAPET = 3.69
FLOOR TO FLOOR
= 14.0' ÷ 2 = 7.00
10.69 ft.

FORCE AT THE ROOF LEVEL

$10.69 \times 1.3 \times 33 = 458.6$ p.l.f.

$.4586 \times \frac{148.66}{2} = 34.09$ KIPS $\boxed{\frac{2}{W\text{-}2}}$ $\quad .4586 \times \frac{87.33}{2} = 20.02$ KIPS $\boxed{\frac{3}{W2}}$

UPLIFT ON ROOF = 33 × .70 = 23.1 p.s.f.
ROOF D.L. = 98 p.s.f. ∴ NO NET UPLIFT
CONCRETE CANOPY UPLIFT = 33 × 1.25 = 41.25 p.s.f.
CONCRETE CANOPY D. L. = 56.25 × .9 = 50.63 p.s.f.
∴ NO NET UPLIFT
(NON CRITICAL ELEMET)

ROOF WIND ANALYSIS

CHECK ROOF DIAPHRAGM SHEAR (7½"×16" JOIST + 2½" SLAB)

WIND LOAD = 34.09^{K} (SHEET AM-W1)

LOAD FACTOR FOR WIND = 1.3

$V_u = 1.3 \times 34.09 = 44.3$ KIPS

$$v_u = \frac{44300}{.85 \times 2.5 \times (87.33 \times 12 \times .8)} = 24.9 \text{ p.s.i.}$$

$v_{C\,ALLOW.} = 2\sqrt{2500} = 100$ p.s.i.

$$\text{STRESS RATIO} = \frac{f_w}{f_a} = \frac{24.9}{100} = 0.25 \text{ (SHEAR)}$$

CHORD STRESS

$$M = \frac{.4586 \times (148.66)^2}{8} = 1266.9^{IK} \qquad T = \frac{1266.9 \times 1.3}{86.5} = 19.0 \text{ KIPS}$$

$$A_S = \frac{19}{.9 \times 40} = 0.53 \text{ SQ.IN. (SHEET AM-E9 } A_S = 2.20)$$

$$\text{STRESS RATIO} = \frac{0.53}{2.20} = 0.24 \text{ (FLEXURAL TENSION)}$$

CHECK WALL PIERS 2ND STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR

NORTH - SOUTH

TOTAL WIND LOAD = 2 × 34.09 = 68.18 KIPS (SHEET W2)

COMPARE WITH SEISMIC ANALYSIS FOR METHOD

SEISMIC LOAD = 265.63 KIPS (SHEET AM-E4)

$$\text{RATIO WIND TO SEISMIC} = \frac{68.18}{265.63} = 0.257$$

$$\text{FACTOR FOR FLEXURE} = 0.257 \times \frac{1.3}{1.4} = .239$$

$$\text{FACTOR FOR SHEAR} = 0.257 \times \frac{1.3}{2.8} = .119$$

(U.B.C. SECTION 2609(d) AND 2627(a))

WALL B & D

PIER 1 & 4 2-#7 JAMB BARS = 1.20 SQ.IN. (FROM PLANS)

SEISMIC A_S = 1.28 SQ.IN. v_u = 237 p.s.i. (SHEET AM-E6)

WIND A_S = 1.28 × .239 = 0.31 SQ.IN.

$$\text{STRESS RATIO} = \frac{0.31}{1.20} = 0.26 \text{ (FLEXURAL TENSION)}$$

ROOF WIND ANALYSIS

CHECK WALL PIERS 2^{ND} STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR (CONT.)

WALL B & D (CONT.)

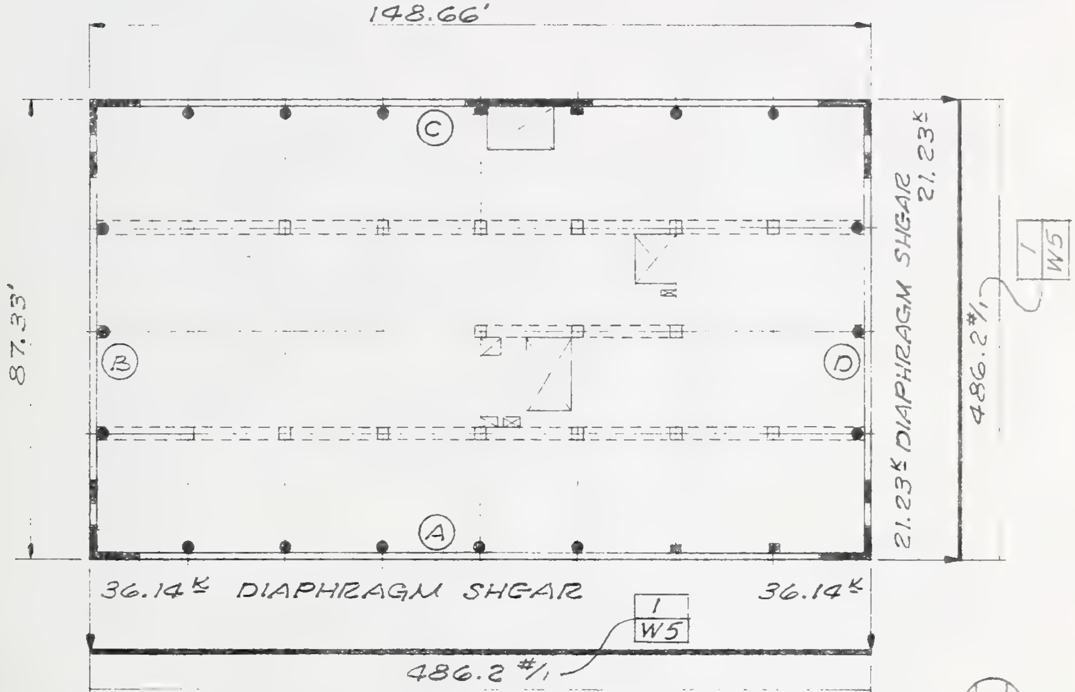
WIND v_u = 237 x .119 = 28.2 p.s.i.

STRESS RATIO = $\frac{28.2}{180}$ = 0.157 (SHEAR)

180 p.s.i. = ALLOWABLE v_u FOR 10" CONCRETE WALLS REINFORCED WITH #4 @ 20" o.c. B.W. B.F. (SHEET AM-E6)

THESE WERE THE ONLY CRITICAL 2^{ND} STORY WALLS AND PIERS FOR EARTHQUAKE LOAD SINCE THE WIND LOAD IS LESS THAN THE EARTHQUAKE LOAD. THE REMAINING WALLS AND PIERS DO NOT REQUIRE CHECKING.

SECOND FLOOR WIND ANALYSIS



LOADS FOR 2^ND FLOOR DIAPHRAGM

100 M.P.H. WIND EXPOSURE C

ELEVATION ROOF = 28'-0"
ELEVATION 2^ND FLOOR = 14'-0"

WALL TRIBUTARY TO 2^ND FLOOR = 14'-0"

FORCE AT THE SECOND FLOOR LEVEL

6' AT 33 #/□' = 198
8' AT 22 #/□' = 176
1.3 x 374 #/' = 486.2 p.l.f. 1/W5

UPLIFT CONCRETE CANOPY. 22 x 1.25 = 27.5 p.s.f.
CANOPY D.L. = 56.25 x .9 = 50.63 p.s.f. } ∴ NO NET UPLIFT
CANOPY D.L. = 67.7 x .9 = 60.9 p.s.f. } (NON CRITICAL ELEMENT)

DIAPHRAGM SHEAR = $.4862 \times \frac{148.66}{2} = 36.14$ KIPS

$.4862 \times \frac{87.33}{2} = 21.23$ KIPS

SECOND FLOOR WIND ANALYSIS

CHECK WALL PIERS 1ST STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR

NORTH-SOUTH

TOTAL WIND LOAD = 2 × 36.14 = 72.28 KIPS (SHEET AM-W5)
+ 68.18 (SHEET AM-W3)
V_2 = 140.46 KIPS

COMPARE WITH SEISMIC ANALYSIS FOR METHOD

SEISMIC LOAD V_2 = 600.6 KIPS (SHEET AM-E11)

RATIO WIND TO SEISMIC = $\frac{140.46}{600.6}$ = 0.233

FACTOR FOR FLEXURE = 0.233 × $\frac{1.3}{1.4}$ = 0.216

FACTOR FOR SHEAR = 0.233 × $\frac{1.3}{2.8}$ = 0.108

WALL B & D

PIER 1 & 4 2-#10 JAMB BARS EXISTING = 2.54 SQ. IN.

SEISMIC A_s = 3.0 SQ. IN. v_u = 531.9 p.s.i. (SHEET AM-E14)

WIND A_s = 3 × .216 = 0.65 SQ. IN.

STRESS RATIO = $\frac{0.65}{2.54}$ = 0.26 (FLEXURAL TENSION)

WIND v_u = 531.9 × .108 = 57.4 p.s.i.

STRESS RATIO = $\frac{57.4}{180}$ = 0.319 (SHEAR)

PIER 2 & 3 2-#10 JAMB BARS EXISTING = 2.54 SQ. IN.

SEISMIC A_s = 1.99 SQ. IN. v_u = 343.1 p.s.i. (SHEET AM-E14)

WIND A_s = 1.99 × .216 = 0.43 SQ. IN.

STRESS RATIO = $\frac{0.43}{2.54}$ = 0.17 (FLEXURAL TENSION)

WIND v_u = 343.1 × .108 = 37.1 p.s.i.

STRESS RATIO = $\frac{37.1}{180}$ = 0.21 (SHEAR)

SECOND FLOOR WIND ANALYSIS

CHECK WALL PIERS 1ST STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR

EAST-WEST

TOTAL WIND LOAD = 2 × 20.02 = 40.04 (SHEET AM-W2)
+ 2 × 21.23 = 42.46 (SHEET AM-W5)
V_2 = 82.50 KIPS

COMPARE WITH SEISMIC ANALYSIS FOR METHOD

SEISMIC LOAD V_2 = 600.6 KIPS (SHEET AM-E11)

RATIO WIND TO SEISMIC $= \frac{82.5}{600.6} = 0.137$

FACTOR FOR FLEXURE $= 0.137 \times \frac{1.3}{1.4} = 0.127$

FACTOR FOR SHEAR $= 0.137 \times \frac{1.3}{2.8} = 0.064$

WALL A

PIER 1 & 4 2-#7 JAMB BARS EXISTING = 1.20 SQ. IN.

SEISMIC A_s = 1.43 SQ. IN. v_u = 261.5 (SHEET AM-E14 & E15)

WIND A_s = 1.43 × .127 = 0.18 SQ. IN.

STRESS RATIO $= \frac{0.18}{1.20} = 0.15$ (FLEXURAL TENSION)

WIND v_u = 261.5 × .064 = 16.7 p.s.i.

STRESS RATIO $= \frac{16.7}{180} = 0.09$ (SHEAR)

WALL C

PIER 1 & 4 2-#7 JAMB BARS EXISTING = 1.20 SQ. IN.

SEISMIC A_s = 1.36 SQ. IN. v_u = 249.3 p.s.i. (SHEET AM-E15 & E16)

WIND A_s = 1.36 × .127 = 0.17 SQ. IN.

STRESS RATION $= \frac{0.17}{1.20} = 0.14$ (FLEXURAL TENSION)

WIND v_u = 249.3 × .064 = 16.0

STRESS RATIO $= \frac{16}{180} = .09$ (SHEAR)

SINCE THE EARTHQUAKE ANALYSIS SHOWED THE OTHER PIERS TO BE NON CRITICAL, THE SMALLER WIND LOADS WOULD ALSO NOT OVER STRESS THE REMAINING PIERS.

SECOND FLOOR WIND ANALYSIS

CHECK SECTION OF WALL ALONG THE CORNER

FOR A VERTICAL STRIP OF WIDTH 0.1W = 0.1 x 87.33 = 8.73'
A PRESSURE COEFFICIENT - 2.0 IS USED: 33 x 2 = 66 p.s.f.

COMPARE WITH SEISMIC ANALYSIS ON SHEET AM-E20 FOR METHOD.

SEISMIC LOAD = 39 p.s.f.

RATIO OF WIND FORCE TO SEISMIC FORCE $= \frac{66}{39} = 1.69$

FACTOR FOR FLEXURE (LOAD FACTOR RATIO) $= 1.69 \times \frac{1.3}{1.4} = 1.57$

WIND f_m = 417.2 (SHEET AM-E20) x 1.57 = 655.0 p.s.i.
$+ f_a$ = 11.7 (SHEET AM-E20)
666.7 p.s.i.

STRESS RATIO $= \frac{666.7}{2500} = .27$ (FLEXURAL COMPRESSION)

A_s SEISMIS = .086 (SHEET AM-E20)

A_s WIND = 1.57 x .086 = 0.14 SQ. IN.

STRESS RATIO $= \frac{.14}{.12} = 1.17$ (FLEXURAL TENSION)

NOTE: THESE WALLS HAVE CONTINUITY WITH THE FOOTINGS AND THE 1ST AND 2ND FLOORS. THE MOMENT USED IN THE SEISMIC ANALYSIS (SHEET AM-E20) WAS $WL/8$ THEREFORE USE $WL/10$ THEN STRESS RATIO = 1.17 x .8 = 0.94 IN ADDITION THIS FORCE IS CONSIDERED ACTING AT A CORNER WHERE THE MOMENT OF INERTIA IS LARGER AND THE REQUIRED A_s SMALLER. THEREFORE THE ACTUAL STRESS RATIO IS DEFINITELY LESS THAN 1.0.

C. Tornado

For this example the building is assumed to be subject to tornado hazard with probability of occurrence once in a 100-year period.

No original computations for tornado hazards were available. The computations made for this example consist of the determination of tornado wind pressures, positive and negative, and the distribution of these forces to the building. A brief check is made on the probability of glass breakage and window frame anchorage. The anchorage of the thin precast concrete veneer panels is considered satisfactory. The elements felt to be probably the most critical were the roof framing elements subjected to negative or uplift pressure and the shear walls subjected to horizontal pressure. The critical stress ratios of these elements were computed.

As noted in Section 3.3 under "Criteria for the Method," the suction or uplift on the roof for moderate tornado protection is assumed to be 172 psf and the horizontal velocity pressure is assumed to be 100 psf. In this building the height/width ratio is less than 2.5, so the windward and leeward coefficients will be 0.8 and 0.5, respectively. Calculation Sheet T3 computes the total uplift on the building. The horizontal force loading diagram is shown for loads applied at the roof level on Sheet T2. On sheet T4, the uplift on the individual roof concrete joists and girders is acceptable. Since the uplift on these members is greater than the dead load, these members are checked in detail since these are potential critical members.

Since computations for this example have already been made for earthquake and the distribution of lateral forces to the various shear walls and piers determined, it was not necessary to repeat this for tornado. A ratio of tornado forces to seismic forces is computed at each level and these ratio factors used in determining the critical stress ratios shown on Sheets T5, T7 and T8 for vertical resisting elements.

A typical wall panel is checked for direct normal pressure on Sheet T9. The maximum diaphragm shear from tornado forces is shown on Sheet T5.

The anchorage of the roof to the walls is accomplished by the vertical wall steel and column bars. This is calculated on Sheet T3.

Since there was no net uplift on the structure, the footings and footing anchorage critical stress ratios are listed as less than 0.46, the critical ratio of uplift forces alone.

The glass and glazing items listed under "Other Life Hazards" are rated as "Compliance" with normal wind requirements. It is known from experience that such normal compliance will not prevent damage in a tornado. However, the window frame anchorage was found to be reasonably adequate.

APPROXIMATE ANALYTICAL METHOD
RATING FORM - TORNADOES

SYSTEMS CRITICAL STRESS RATIOS*

SYSTEM	f_T/f_a **
Roof	1.10
Roof Anchorage	.44
Floor	.76
Floor Anchorage	<1.0
Vertical Resisting Element	.83
Anchorage to Footings	< .46
Footings	<.46

*Use highest Critical Stress Ratio.
For Structural Systems Rating - Tornado, see Form AME.

**f_T = Capacity required to resist tornado forces.

f_a = Capacity based on design criteria.

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - TORNADO RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING
Glass Breakage*	------	COMPLIANCE
Glazing*	--------	COMPLIANCE
Window Frame Anchorage	<2.0	GOOD
Wall Cladding Anchorage	<2.0	GOOD
Anchorage of Exterior Appendages	--------	
Exposed Walls	1.34	GOOD
Canopies & Eaves	3.40	POOR

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE*

TYPE	QUANTITY	DISTANCE
LUMBER YARD	LARGE	400'

*See Instructions for ratings.

CRITICAL STRESS RATIO	RATING
< 2.0	Good
2.0 to 3.0	Fair
> 3.0	Poor

DESIGN CRITERIA

LOAD CRITERIA

ROOF DEAD LOADS

5 PLY ROOFING + GRAVEL	= 7.0 p.s.f.
JOISTS	= 72.0
BEAMS	= 9.0
CEILING	= 10.0
	98.0 p.s.f.

CONCRETE WALLS = 150 p.c.f.

2½" PRECAST CONCRETE VENEER = 31.25 p.s.f.

ROOF LIVE LOADS = 20.0 p.s.f.

TORNADO CRITERIA

EFFECTIVE VELOCITY PRESSURE q_F FOR TORNADO = 100 p.s.f.

EXTERNAL PRESSURE COEFFICIENTS FOR WALLS, C_p

WINDWARD WALL	= 0.8
LEEWARD WALL	= 0.5
TOTAL DESIGN TORNADO	= 1.3

UPLIFT PRESSURE ON ROOF = 172 p.s.f.

FROM ACI 318-71

REQUIRED STRENGTH $U = 0.9D + 1.3W$

WHERE THE SPECIFIED TORNADO LOADS = 1.3 W

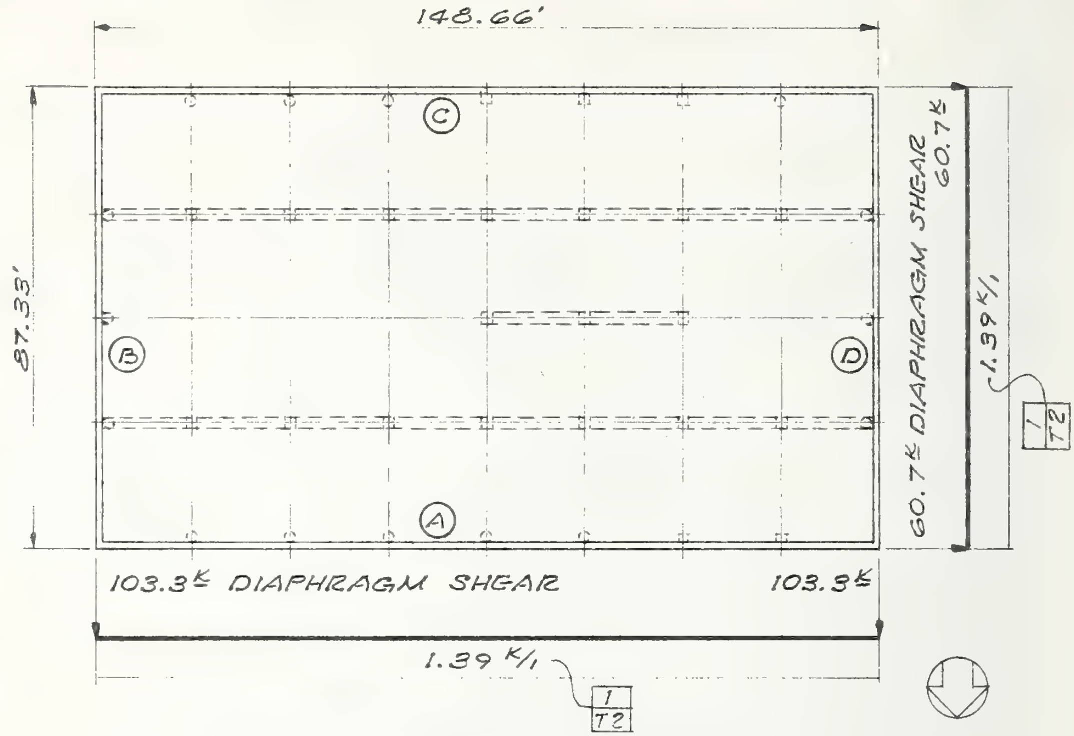
DESIGN CRITERIA (FROM THE PLANS & SPECIFICATIONS)

CONCRETE f'_c = 25000 p.s.i.

REINFORCING STEEL f_y = 40,000 p.s.i.

ALLOWABLE SOIL PRESSURE = 1800 p.s.f. (DEAD + LIVE)

ROOF TORNADO ANALYSIS



LOADS FOR ROOF DIAPHRAGM

TORNADO FORCES

UPLIFT = 172 #/□'

HORIZONTAL = 1.3 x 100 = 130 p.s.f

DIAPHRAGM = 10.69 x 130 = 1390 p.l.f 1/T2

DIAPHRAGM SHEAR

$$1.39 \times \frac{148.66}{2} = 103.3 \text{ KIPS}$$

$$1.39 \times \frac{87.33}{2} = 60.7 \text{ KIPS}$$

WALL TRIBUTARY TO ROOF

PARAPET = 3.69

FLOOR TO ROOF = 14 ÷ 2 = 7.00

10.69 f,

ROOF TORNADO ANALYSIS

CHECK ROOF DIAPHRAGM SHEAR
(7½" x 16" JOISTS + 2½" SLAB)

TORNADO LOAD = 103.3 KIPS (SHEET AM-T2)

V_u = 103.3 KIPS

$$v_u = \frac{103,300}{.85 \times 2.5\,(87.33 \times 12 \times .8)} = 58.0 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{58.0}{100} = 0.58 \text{ (SHEAR)} \; (v_{c\,ALLOW.} = 100 \text{ p.s.i. SHEET AM-W3})$$

CHORD STRESS

$$M = 1.39 \times (148.66)^2 \div 8 = 3839.8 \text{ FT. KIPS}$$

$$T = \frac{3839.8}{86.5} = 44.4 \text{ KIPS}$$

$$A_S = \frac{44.4}{.9 \times 40} = 1.23 \text{ SQ. IN.}$$

$$\text{STRESS RATIO} = \frac{1.23}{2.20} = 0.56 \text{ (FLEXURAL TENSION)(SHEET AM-E9)}$$

CHECK TORNADO UPLIFT ON ROOF

TOTAL UPLIFT ON ROOF = .172 p.s.f. x 87.33 x 148.66 = 2233.0 KIPS

DEAD LOAD RESISTANCE TO UPLIFT

ROOF = 0.9 x .098 x 87.33 x 148.66 = 1145.1

WALLS A = 222.08
B = 132.99
C = 234.51
D = 132.99 (SHEET AM-E10)
722.57 x .9 = 650.3

1795.4 KIPS

APPROXIMATE RESISTANCE BY REINFORCEMENT

INTERIOR COLUMNS 4-#9 = 4.0 x 17 = 68.0 SQ. IN.
EXTERIOR COLUMNS 4-#7 = 2.4 x 20 = 48.0 SQ. IN.
116.0 SQ. IN.

.9 x 116.0 x 40 k.s.i. = 4176.0

TOTAL RESISTANCE = 5971.4 KIPS

$$\text{STRESS RATIO} = \frac{f_T}{f_a} = \frac{2233}{5971.4} = .37$$

FROM EARTHQUAKE ANALYSIS THE WEIGHT OF THE BUILDING EXCEPT FOR WALLS AND FOOTINGS BELOW MID 1ST STORY HEIGHT = 2125 + 2680 = 4805 KIPS (DEAD LOAD) (SHEET AM-E2 & AM-E10)

UPLIFT = 2233 KIPS ∴ THERE IS NO NET UPLIFT ON THE BUILDING AS A WHOLE.

ROOF TORNADO ANALSIS

CHECK TORNADO UPLIFT ON ROOF (CONT.)

CHECK UPLIFT ON JOISTS

JOIST SPACING = 3.2'

UPLIFT ON JOIST = 0.172 k.p.s.f.

DEAD LOAD JOIST .072 × .9 = 0.065

NET UPLIFT = 0.107 × 3.2 = 0.342 k.p.l.f.

$$-M = \frac{.342 \times (19.75)^2}{10} = 13.34^{1K}$$

$$+M \text{ EXTERIOR} = \frac{.342 \times (22)^2}{14} = 11.82^{1K}$$

MINIMUM JOIST REINFORCING = 2-#5 BARS BOTTOM = 0.62 SQ.IN.
2-#4 BARS TOP = 0.40 SQ.IN.

$$-f_s = \frac{13.34 \times 12}{.62 \times .875 \times 17} = 17.36 \text{ k.s.i.}$$

$$\text{STRESS RATIO} = \frac{17.36}{40} = 0.43 \text{ (FLEXURAL TENSION)}$$

$$+f_s = \frac{11.82 \times 12}{.40 \times .875 \times 17} = 23.83 \text{ k.s.i.}$$

$$\text{STRESS RATIO} = \frac{23.83}{40} = .72 \text{ (FLEXURAL TENSION)}$$

CHECK UPLIFT ON GIRDERS

GIRDER SPAN = 18.33' (TYPICAL INTERIOR EAST-WEST GIRDERS)

MINIMUM GIRDER REINFORCING = 2-#10 BOTTOM = 2.54 SQ.IN.
2-#4 TOP = 0.40 SQ.IN.

TORNADO UPLIFT = 172.0 p.s.f.

DEAD LOAD JOIST + GIRDERS = 91 × .9 = 81.9 p.s.f.

(72 + 9 + 10 = 91 p.s.f.)(SHEET AM-T1) 90.1 p.s.f NET UPLIFT

$$\text{TRIBUTARY} = \frac{(21.5 + 18.33)}{2} = 19.9'$$

UPLIFT LOAD TO GIRDER = 19.9 × 90.1 = 1792 p.l.f.

$$-M = \frac{1.79 \times (17.33)^2}{10} = 53.8^{1K} \qquad f_s = \frac{53.8 \times 12}{2.54 \times .875 \times 26} = 11.2 \text{ k.s.i.}$$

$$\text{STRESS RATIO} = \frac{11.2}{40} = 0.28 \text{ (FLEXURAL TENSION)}$$

$$+M = \frac{1.79 \times (17.33)^2}{16} = 33.6^{1K} \qquad f_s = \frac{33.6 \times 12}{.4 \times .875 \times 26} = 44.3 \text{ k.s.i.}$$

$$\text{STRESS RATIO} = \frac{44.3}{40} = 1.1 \text{ (FLEXURAL TENSION)}$$

ROOF TORNADO ANALYSIS

CHECK WALL PIERS 2ND STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR

NORTH - SOUTH

TOTAL TORNADO LOAD = 2 x 103.3 = 206.6 KIPS (SHEET AM-T2)

COMPARE WITH SEISMIC ANALYSIS FOR METHOD

SEISMIC LOAD = 265.63 KIPS x 1.4 = 371.9 (SHEET AM-E4)

RATIO OF TORNADO TO SEISMIC $= \frac{206.6}{371.9} = 0.56$

FACTOR FOR FLEXURE = 0.56

FACTOR FOR SHEAR $= \frac{.56}{2} = 0.28$

(U.B.C. SECTION 2609(d) AND 2627(a))

WALL B & D

PIER 1 & 4 2-#7 JAMB BARS = 1.20 SQ. IN (FROM PLAN)

SEISMIC A_s = 1.28 SQ. IN. v_u = 237 p.s.i. (SHEET AM-E6)

TORNADO A_s = 1.28 x .56 = 0.72 SQ. IN.

STRESS RATIO $= \frac{f_T}{f_a} = \frac{0.72}{1.2} = 0.60$ (FLEXURAL TENSION)

TORNADO v_u = 237 x .28 = 66.4 p.s.i.

STRESS RATIO $= \frac{f_T}{f_a} = \frac{66.4}{180} = .37$ (SHEAR)

(FOR v_u = 180 p.s.i. SEE SHEET AM-E6)

THESE WERE THE ONLY CRITICAL 2ND STORY WALLS FOR EARTHQUAKE LOAD. SINCE THE TORNADO LOAD IS LESS THAN EARTHQUAKE LOAD, THESE PIERS ARE ADEQUATE FOR TORNADO.

CHECK 2ND FLOOR DIAPHRAGM SHEAR

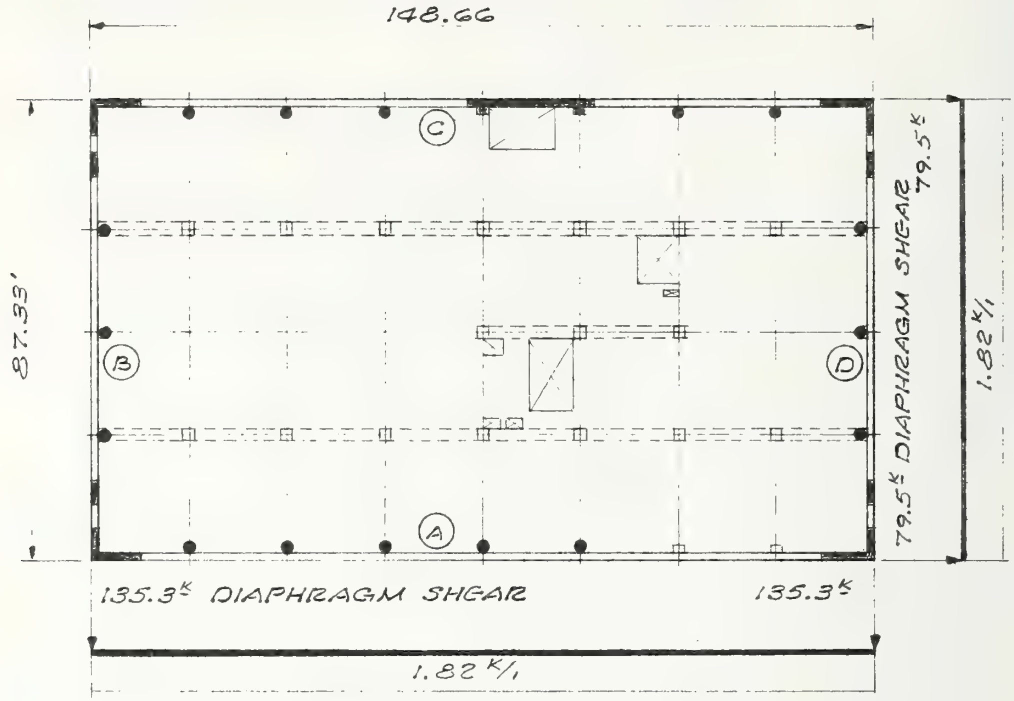
DIAPHRAGM SHEAR = 135.3 KIPS (SHEET AM-T6)

ROOF DIAPHRAGM SHEAR = 103.3 KIPS (SHEET AM-T2)

BY COMPARISON $v_u = \frac{135.3}{103.3} \times 58.0 = 75.9$ p.s.i.

STRESS RATIO $= \frac{75.9}{100} = .76$ (SHEAR)

SECOND FLOOR TORNADO ANALYSIS



LOADS FOR 2ND FLOOR DIAPHRAGM

TORNADO FORCES

WALL TRIBUTARY = 14.0 ft.

HORIZONTAL = 1.3 × 100 = 130 p.s.f.

DIAPHRAGM = 14 × 130 = 1820 p.l.f.

DIAPHRAGM SHEAR

$$1.82 \times \frac{148.66}{2} = 135.3 \text{ KIPS}$$

$$1.82 \times \frac{87.33}{2} = 79.5 \text{ KIPS}$$

UPLIFT CONCRETE CANOPIES = 172.0

CANOPY D.L. = .375 × 150 = 56.25 × .9 = 50.63

NET UPLIFT = 121.37 p.s.f.

CANOPY D.L. = .45 × 150 = 67.5 × .9 = 60.9 p.s.f.

NET UPLIFT = 172 - 60.9 = 111.1 p.s.f.

$$\text{STRESS RATIO} = \frac{172}{50.63} = 3.40 \ \$ \ \frac{172}{60.9} = 2.82$$

SECOND FLOOR TORNADO ANALYSIS

CHECK WALL PIERS 1ST STORY FOR FLEXURAL REINFORCEMENT AND UNIT SHEAR

NORTH-SOUTH

TOTAL TORNADO LOAD = 2 x 135.3 = 270.6 KIPS (SHEET AM-T6)
+ 206.6 (SHEET AM-T5)
V_2 = 477.2 KIPS

COMPARE WITH SEISMIC ANALYSIS FOR METHOD
SEISMIC LOAD V_2 = 600.6 KIPS (SHEET AM-E11) x 1.4 = 840.8

RATIO OF TORNADO TO SEISMIC = $\frac{477.2}{840.8}$ = 0.57

FACTOR FOR FLEXURE = 0.57

FACTOR FOR SHEAR = $\frac{0.57}{2}$ = 0.29

WALL B & D

PIER 1 & 4 2-#10 JAMB BARS EXISTING 2.54 SQ. IN.
SEISMIC A_s = 3.0 SQ. IN. v_u = 531.9 p.s.i. (SHEET AM-E14)
TORNADO A_s = 3 x .57 = 1.71

STRESS RATIO = $\frac{1.71}{2.54}$ = 0.67 (FLEXURAL TENSION)

TORNADO v_u = 531.9 x .29 = 154.3

STRESS RATIO = $\frac{154.3}{180}$ = 0.86 (SHEAR)

PIER 2 & 3 2-#10 JAMB BARS EXISTING = 2.54 SQ. IN.
SEISMIC A_s = 1.99 SQ. IN. v_u = 343.1 p.s.i. (SHEET AM-E14)
TORNADO A_s = 1.99 x .57 = 1.13 SQ. IN.

STRESS RATIO = $\frac{1.13}{2.54}$ = 0.45 (FLEXURAL TENSION)

TORNADO v_u = 343.1 x .29 = 99.5 p.s.i.

STRESS RATIO = $\frac{99.5}{180}$ = 0.55 (SHEAR)

SECOND FLOOR TORNADO ANALYSIS

EAST - WEST

TOTAL TORNADO LOAD = 2 x 79.5 = 159.0 KIPS (SHEET AM-T6)
+ 2 x 60.7 = 121.4 (SHEET AM-T2)
280.4 KIPS

COMPARE WITH SEISMIC ANALYSIS FOR METHOD

SEISMIC LOAD V_2 = 600.6 KIPS (SHEET AM-E11) x 1.4 = 840.8

RATIO TORNADO TO SEISMIC = $\frac{280.4}{840.8} = 0.33$

FACTOR FOR FLEXURE = 0.33

FACTOR FOR SHEAR = $\frac{0.33}{2} = 0.17$

WALL A

PIER 1 & 4 2-#7 JAMB BARS EXISTING = 1.20 SQ. IN.

SEISMIC A_s = 1.43 SQ. IN. v_u = 261.5 p.s.i. (SHEET AM-E12)

TORNADO A_s = 1.43 x .33 = 0.47 SQ. IN.

STRESS RATIO = $\frac{0.47}{1.20}$ = 0.39 (FLEXURAL TENSION)

TORNADO v_u = 261.5 x .17 = 44.5 p.s.i.

STRESS RATIO = $\frac{44.5}{180}$ = .25 (SHEAR)

WALL C

PIER 1 & 4 2-#7 JAMB BARS EXISTING = 1.20 SQ. IN.

SEISMIC A_s = 1.36 SQ. IN. v_u = 249.3 p.s.i. (SHEET AM-E13)

TORNADO A_s = 1.36 x .33 = .45 SQ. IN.

STRESS RATIO = $\frac{0.45}{1.20}$ = 0.37 (FLEXURAL TENSION)

TORNADO v_u = 249.3 x .17 = 42.4 p.s.i.

STRESS RATIO = $\frac{42.4}{180}$ = .24 (SHEAR)

SINCE THE EARTHQUAKE ANALYSIS SHOWNED THE OTHER PIERS TO BE NON CRITICAL THE SMALLER TORNADO LOADS WOULD ALSO NOT OVERSTRESS THE REMAINING PIERS.

SECOND FLOOR TORNADO ANALYSIS

CHECK SECTION OF WALL BETWEEN DIAPHRAGMS

COMPARE WITH SEISMIC ANALYSIS ON SHEET AM-E20 FOR METHOD

TORNADO LOAD = 0.80 × 100 = 80 p.s.f. (SHEET AM-T1)

SEISMIC LOAD = 39 p.s.f. × 1.4 = 54.6 p.s.f.

RATIO TORNADO TO SEISMIC = $\frac{80}{54.6}$ = 1.47

TORNADO f_m = 417.2 (SHEET AM-E20) × 1.47 = 613.3
$+f_a$ = 11.7
625.0 p.s.i.

STRESS RATIO = $\frac{625}{2500}$ = 0.25 (FLEXURAL COMPRESSION)

A_s SEISMIC = .086 (SHEET AM-E20)

A_s TORNADO = 1.47 × .086 = 0.13 SQ. IN.

STRESS RATIO = $\frac{.13}{.12}$ = 1.08 (FLEXURAL TENSION)

WHILE $^{wl}/_{8}$ MOMENT WAS USED FOR SEISMIC ANALYSIS THE WALLS HAVE CONTINUITY WITH THE FOOTINGS AND 1ST AND 2ND FLOORS AND IS MORE LIKE $^{wl}/_{10}$. THEN STRESS RATIO = 1.08 × .8 = 0.86

D. Resume

Earthquake

The Approximate Analytical Evaluation Method gives this building a rating of "Very Poor" for the 9.5 Modified Mercalli Scale Intensity earthquake used for this site. This is an extremely high intensity and this building would rate better for earthquakes with a lower MMI.

The Exit Enclosure Walls are rated "Fair" to "Good." There is no problem with Partitions and Wall Cladding, but the Ceilings and Light Fixtures are not laterally braced and these Life Hazards are rated "Poor."

Wind

The Basic Wind Speed applicable to this site has been designated as 100 miles per hour, which is of hurricane velocity. The rating of the Structural System as a whole is "Good," however. There appears to be no problem with Other Life Hazards except that there is a potential hazard from windblown debris from the lumber yard 400 feet away.

Tornado

This building rates "Good" for Tornado hazard as far as the structural system as a whole is concerned. Because top reinforcing steel was provided in the concrete joists and girders, the roof was found capable of taking the uplift forces below ultimate strength of concrete or yield stress in the reinforcing steel. The diaphragm critical stress ratio is 1.0. The diaphragm shears here are the same as for Earthquake. There is a potential hazard from windblown missiles from the lumber yard 400 feet away.

APPROXIMATE ANALYTICAL METHOD
CRITICAL STRESS RATIOS - STRUCTURAL SYSTEMS

	Critical Stress Ratio	Rating
Earthquake	2.96	VERY POOR
Wind	0.94	GOOD
Tornado	1.10	GOOD

RATING OF CRITICAL STRESS RATIOS

Critical Stress Ratio	Earthquake or Wind	Tornado
Less than 1.0	Good	Good
1 to 1.5	Fair	Good
1.5 to 2.0	Poor	Good
2.0 to 3.0	Very Poor	Fair
3.0 to 4.0	Very Poor	Poor
Over 4.0	Very Poor	Very Poor

4.5 DETAILED ANALYTICAL EVALUATION METHOD

The same two-story reinforced concrete building evaluated by the Field Evaluation and the Approximate Analytical Evaluation Methods is evaluated in this section. It was assumed that the building is subjected to an earthquake of Richter magnitude of 7.0 with a hypocentral distance of 10 miles. This earthquake is equivalent to MMI of 9.54 according to equation (3.4.3). For wind and tornado load analysis, wind velocities of 100 and 200 miles per hour, respectively were used.

A listing of the computer program results is contained on the following pages.

FORTRAN IV COMPUTER PROGRAM LISTING

EXAMPLE 1 TWO STORY CONCRETE SHEAR-WALL BUILDING

```
INCLUDE EARTHQUAKE HAZARD:   1

INCLUDE WIND HAZARD:         1

INCLUDE TORNADO HAZARD:      1

SITE LOCATION: LATITUDE   34.20  DEGREES, LONGITUDE  118.50  DEGREES

EXERCISE RISK OPTION:        0

BUILDING MODELING OPTION:      1

EVALUATE DAMAGE TO LONG-SPAN ROOF:    1
```

E A R T H Q U A K E   L O A D   A N A L Y S I S

HARD ROCK GROUND MOTION CHARACTERISTICS

```
        RICHTER MAGNITUDE              =   7.00+00
        HYPOCENTRAL DISTANCE (MILES)   =   1.00+01
        HARD ROCK ACCELERATION (G)     =   1.37-01
        HARD ROCK VELOCITY (IN/SEC)    =   8.18+00
        HARD ROCK DISPLACEMENT (IN)    =   2.69+00
```

```
DEPTH TO WATER TABLE =   40.00
SOIL CODE. . . . . . =       2
```

BASE SPECTRUM IN TERMS OF THE MEAN AND .00 STANDARD DEVIATIONS

PERIOD (SEC)	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
PSV (IN/SEC)	2.36	4.72	7.09	9.45	11.81	14.17	16.54	18.90	21.26	22.95
PERIOD (SEC)	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00
PSV (IN/SEC)	22.95	22.95	22.95	22.95	22.95	22.95	22.95	22.95	22.95	22.95
PERIOD (SEC)	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00
PSV (IN/SEC)	22.57	21.54	20.61	19.75	18.96	18.23	17.55	16.93	16.34	15.80
PERIOD (SEC)	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00
PSV (IN/SEC)	15.29	14.81	14.36	13.94	13.54	13.17	12.81	12.47	12.15	11.85
PERIOD (SEC)	4.10	4.20	4.30	4.40	4.50	4.60	4.70	4.80	4.90	5.00
PSV (IN/SEC)	11.56	11.28	11.02	10.77	10.53	10.30	10.08	9.87	9.67	9.48
PERIOD (SEC)	5.10	5.20	5.30	5.40	5.50	5.60	5.70	5.80	5.90	6.00
PSV (IN/SEC)	9.29	9.11	8.94	8.78	8.62	8.46	8.32	8.17	8.03	7.90
PERIOD (SEC)	6.10	6.20	6.30	6.40	6.50	6.60	6.70	6.80	6.90	7.00
PSV (IN/SEC)	7.77	7.64	7.52	7.41	7.29	7.18	7.07	6.97	6.87	6.77
PERIOD (SEC)	7.10	7.20	7.30	7.40	7.50	7.60	7.70	7.80	7.90	8.00
PSV (IN/SEC)	6.68	6.58	6.49	6.40	6.32	6.24	6.16	6.08	6.00	5.92
PERIOD (SEC)	8.10	8.20	8.30	8.40	8.50	8.60	8.70	8.80	8.90	9.00
PSV (IN/SEC)	5.85	5.78	5.71	5.64	5.58	5.51	5.45	5.39	5.33	5.27
PERIOD (SEC)	9.10	9.20	9.30	9.40	9.50	9.60	9.70	9.80	9.90	10.00
PSV (IN/SEC)	5.21	5.15	5.10	5.04	4.99	4.94	4.89	4.84	4.79	4.74

```
W I N D   L O A D   A N A L Y S I S

ISITE=     3     ITEST=     2     ITY=     0     ISHAPE=     1

 USERS VALUE OF WIND VELOCITY -FASTEST MILE AT 30 FT ABOVE GROUND - FREE FIELD IN MPH =     100.00




        T O R N A D O   L O A D   A N A L Y S I S

      TORNADO WIND VELOCITY =  200.00  MILES PER HOUR

      LIFE TIME OF BUILDING IN YEARS =   50.00
      ANNUAL NUMBER OF TORNADOS. . . =     .00
      PROBABILITY OF BEING HIT . . . =   0.000
```

NUMBER OF STORIES =   2

TOTAL BUILDING WIDTH (INCHES) = 1050.0

TOTAL BUILDING LENGTH (INCHES) = 1780.0

HEIGHT OF PARAPET (INCHES)   =   45.0

NUMBER OF FRAMES =   9

*** FRAME NO. 1 ***   FRAME MODELING OPTION =   2

NUMBER OF BAYS =   5

BEAMS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00
COLUMNS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00

BEAM TYPE	AB	IB	FB
1	720.0	121500.0	1.20

COLUMN TYPE	AC	IC	FC
1	860.0	530046.7	1.20
2	600.0	180000.0	1.20
3	201.1	3217.0	1.11

BAY WIDTHS ------

1 BAYS AT   122.000 INCHES
1 BAYS AT   109.000 INCHES
1 BAYS AT   440.000 INCHES
1 BAYS AT   109.000 INCHES
1 BAYS AT   122.000 INCHES

STORY HEIGHTS -------

2 STORIES AT   168.000 INCHES

*** FRAME NO. 2 ***   FRAME MODELING OPTION =   2

NUMBER OF BAYS =   5

BEAMS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00

COLUMNS E= 3000.0 G= 1300.0 W(LBS/CU.FT)= 150.00

BEAM TYPE	AB	IB	FB
1	720.0	121500.0	1.20

COLUMN TYPE	AC	IC	FC
1	860.0	530046.7	1.20
2	600.0	180000.0	1.20
3	201.1	3217.0	1.11

BAY WIDTHS ------

1 BAYS AT 122.000 INCHES
1 BAYS AT 109.000 INCHES
1 BAYS AT 440.000 INCHES
1 BAYS AT 109.000 INCHES
1 BAYS AT 122.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

*** FRAME NO. 3 *** FRAME MODELING OPTION = 2

NUMBER OF BAYS = 3

BEAMS E= 3000.0 G= 1300.0 W(LBS/CU.FT)= 150.00

COLUMNS E= 3000.0 G= 1300.0 W(LBS/CU.FT)= 150.00

BEAM TYPE	AB	IB	FB
1	300.0	8814.2	2.16

COLUMN TYPE	AC	IC	FC
1	201.1	3217.0	1.11
2	324.0	8748.0	1.20
3	400.0	13333.3	1.20

BAY WIDTHS ------

1 BAYS AT 296.000 INCHES
1 BAYS AT 440.000 INCHES
1 BAYS AT 296.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

*** FRAME NO. 4 *** FRAME MODELING OPTION = 2

NUMBER OF BAYS = 3

BEAMS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00
COLUMNS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00

BEAM TYPE	AB	IB	FB
1	300.0	8814.2	2.16

COLUMN TYPE	AC	IC	FC
1	201.1	3217.0	1.11
2	324.0	8748.0	1.20
3	400.0	13333.3	1.20

BAY WIDTHS ------

1 BAYS AT 296.000 INCHES
1 BAYS AT 440.000 INCHES
1 BAYS AT 296.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

*** FRAME NO. 5 *** FRAME MODELING OPTION = 2

NUMBER OF BAYS = 3

BEAMS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00
COLUMNS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00

BEAM TYPE	AB	IB	FB
1	300.0	8814.2	2.16

COLUMN TYPE	AC	IC	FC
1	201.1	3217.0	1.11
2	324.0	8748.0	1.20
3	400.0	13333.3	1.20

BAY WIDTHS ------

1 BAYS AT 296.000 INCHES
1 BAYS AT 440.000 INCHES
1 BAYS AT 296.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

*** FRAME NO. 6 *** FRAME MODELING OPTION = 2

NUMBER OF BAYS = 3

BEAMS E= 3000.0 G= 1300.0 W(LBS/CU.FT)= 150.00

COLUMNS E= 3000.0 G= 1300.0 W(LBS/CU.FT)= 150.00

BEAM TYPE	AB	IB	FB
1	300.0	8814.2	2.16

COLUMN TYPE	AC	IC	FC
1	201.1	3217.0	1.11
2	324.0	8748.0	1.20
3	400.0	13333.3	1.20

BAY WIDTHS ------

1 BAYS AT 296.000 INCHES
1 BAYS AT 440.000 INCHES
1 BAYS AT 296.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

*** FRAME NO. 7 *** FRAME MODELING OPTION = 2

NUMBER OF BAYS = 4

BEAMS E= 3000.0 G= 1300.0 W(LBS/CU.FT)= 150.00

COLUMNS E= 3000.0 G= 1300.0 W(LBS/CU.FT)= 150.00

BEAM TYPE	AB	IB	FB
1	420.0	14014.5	1.51
2	394.0	12473.8	1.12
3	492.0	16516.4	1.36

COLUMN TYPE	AC	IC	FC
1	348.0	7424.0	1.20
2	324.0	8748.0	1.20
3	256.0	5461.3	1.20
4	201.1	3217.0	1.11
5	400.0	13333.3	1.20

BAY WIDTHS ------

1 BAYS AT 296.000 INCHES
2 BAYS AT 220.000 INCHES
1 BAYS AT 296.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

*** FRAME NO. 8 *** FRAME MODELING OPTION = 2

NUMBER OF BAYS = 4

BEAMS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00
COLUMNS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00

BEAM TYPE	AB	IB	FB
1	420.0	14014.5	1.51
2	394.0	12473.8	1.12
3	492.0	16516.4	1.36

COLUMN TYPE	AC	IC	FC
1	348.0	7424.0	1.20
2	324.0	8748.0	1.20
3	256.0	5461.3	1.20
4	201.1	3217.0	1.11
5	400.0	13333.3	1.20

BAY WIDTHS ------

1 BAYS AT 296.000 INCHES
2 BAYS AT 220.000 INCHES
1 BAYS AT 296.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

*** FRAME NO. 9 *** FRAME MODELING OPTION = 2

NUMBER OF BAYS = 4

BEAMS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00
COLUMNS	E=	3000.0	G=	1300.0	W(LBS/CU.FT)=	150.00

BEAM TYPE	AB	IB	FB

1	420.0	14014.5	1.51
2	402.0	12679.5	1.11

COLUMN TYPE	AC	IC	FC
1	201.1	3217.0	1.11
2	324.0	8748.0	1.20
3	256.0	5461.3	1.20
4	495.0	16500.0	1.20
5	400.0	13333.3	1.20
6	522.0	14094.0	1.20

BAY WIDTHS ------

1 BAYS AT 296.000 INCHES
2 BAYS AT 220.000 INCHES
1 BAYS AT 296.000 INCHES

STORY HEIGHTS -------

2 STORIES AT 168.000 INCHES

STIFFNESS MATRIX (K1PS/IN)

6.03+03	-9.33+03
-9.33+03	2.55+04

TOTAL WEIGHT VECTOR (KIPS)

1.84+03
2.34+03

CHARACTERISTIC VECTORS

```
1.00+00  -5.21-01
4.11-01   1.00+00
```

E A R T H Q U A K E   R E S P O N S E   A N A L Y S I S

DAMPING CURVE OPTION =   1

MAXIMUM NUMBER ITERATIONS =   6

MODIFY RESPONSE FOR DUCTILITY =   1

MODAL COMBINATION OPTION =   2

EFFECTIVE INTERSTORY DRIFT TO YIELD BY STORY (IN/IN)

6.00-03   6.00-03

CRITICAL DAMPING (PERCENT) =   6.62

MODE NO.	FREQUENCY (CPS)	PERIOD (SEC.)	MASS RATIO	PSUDO-SPECTRAL VELOCITY	MAXIMUM BASE SHEAR	AMPLITUDE RATIO	PS.SPECT.VEL. MODIFIED FOR DUCTILITY (ACCEL)	(DISPL)
1	3.4126	.293	.840	12.036	2346.225	.798	12.036	12.036
2	10.0000	.100	.160	2.362	256.670	2.061	2.362	2.362

STORY NO.	I. S. DEFL (IN)	VELOCITY (IN/SEC)	ACCELERATION (G)
1	4.4204-01	1.5676+01	9.3388-01
2	3.0720-01	7.3419+00	5.3021-01

DUCTILITY BY STORY

4.39-01   3.05-01

EFFECTIVE DUCTILITY FOR BUILDING =   .35

CRITICAL DAMPING (PERCENT) =   3.87

MODE NO.	FREQUENCY (CPS)	PERIOD (SEC.)	MASS RATIO	PSUDO-SPECTRAL VELOCITY	MAXIMUM BASE SHEAR	AMPLITUDE RATIO	PS.SPECT.VEL. MODIFIED FOR DUCTILITY (ACCEL)	(DISPL)
1	3.4125	.293	.840	13.058	2545.280	.798	13.058	13.058
2	9.9997	.100	.160	2.362	256.670	2.061	2.362	2.362

STORY NO.	I. S. DEFL (IN)	VELOCITY (IN/SEC)	ACCELERATION (G)
1	4.7721-01	1.6956+01	1.0049+00
2	3.3174-01	7.8678+00	5.5938-01

DUCTILITY BY STORY

4.73-01   3.29-01

EFFECTIVE DUCTILITY FOR BUILDING =   .37

CRITICAL DAMPING (PERCENT) =   4.00

MODE NO.	FREQUENCY (CPS)	PERIOD (SEC.)	MASS RATIO	PSUDO-SPECTRAL VELOCITY	MAXIMUM BASE SHEAR	AMPLITUDE RATIO	PS.SPECT.VEL. MODIFIED FOR DUCTILITY (ACCEL)	(DISPL)
1	3.4124	.293	.840	12.996	2533.137	.798	12.996	12.996
2	9.9994	.100	.160	2.362	256.670	2.061	2.362	2.362

STORY NO.	I. S. DEFL (IN)	VELOCITY (IN/SEC)	ACCELERATION (G)
1	4.7510-01	1.6878+01	1.0005+00
2	3.3026-01	7.8360+00	5.5760-01

DUCTILITY BY STORY

4.71-01 3.28-01

EFFECTIVE DUCTILITY FOR BUILDING = .37

CRITICAL DAMPING (PERCENT) = 3.99

W I N D   R E S P O N S E   A N A L Y S I S

BUILDING SHAPE CODE = 24 WIND DIRECTION CODE = 1

EXTERNAL PRESSURE COEFFICIENT FOR WALL 1 . . .= .800
EXTERNAL PRESSURE COEFFICIENT FOR WALL 2 . . .= -.600
SHAPE FACTOR FOR WIND DIRECTION . . .= 1.400

WIND DIRECTION WITH RESPECT TO
NORMAL OF WALL 1 . . . . = .0 DEGGREES

OPEN AREA RATIO = .360 WALL CODE = 5

WIND ANALYSIS

STORY NO.	DEFLECTION (INCHES)	DRIFT (IN/IN)	STORY SHEAR (KIPS)
1	.014	.0000	23.09
2	.007	.0000	59.94

L O N G S P A N R O O F A N A L Y S I S

```
ANALYSIS CODE . . . . .=    2
SLOPE OF ROOF . . . . .=     .00 DEGREES
ROOF UPLIFT CAPACITY   =   3.400+06 POUNDS
COLLAPSE CAPACITY . . .=   3.000+07 POUNDS
DEPTH OF PONDING  . . .=     .00 FEET
ROOF UPLIFT LOAD. . . .=  -5.574+05 POUNDS
PONDING LOAD. . . . . .=   0.000    POUNDS
```

D A M A G E   A N A L Y S I S

DRIFT TO YIELD BY STORY (FRAME)

6.00-03   6.00-03

COEFFICIENT OF VARIATION BY STORY

1.50-01   1.50-01

DRIFT TO YIELD BY STORY (WALL)

6.00-03   6.00-03

COEFFICIENT OF VARIATION BY STORY

1.50-01   1.50-01

DRIFT TO YIELD BY STORY (DIAPHRAGM)

6.00-03   6.00-03

COEFFICIENT OF VARIATION BY STORY

1.50-01   1.50-01

HEIGHT OF WINDOWS BY STORY (INCHES)

4.80+01   4.80+01

WIDTH OF WINDOWS BY STORY (INCHES)

5.30+01   5.30+01

DUCTILITY TO FAILURE BY STORY (FRAME)

7.00+00   7.00+00

COEFFICIENT OF VARIATION BY STORY

1.50-01   1.50-01

```
DUCTILITY TO FAILURE BY STORY (WALL)

   7.00+00   7.00+00

COEFFICIENT OF VARIATION BY STORY

   1.50-01   1.50-01

DUCTILITY TO FAILURE BY STORY (DIAPHRAGM)

   7.00+00   7.00+00

COEFFICIENT OF VARIATION BY STORY

   1.50-01   1.50-01

QUALITY FACTOR OF CONSTRUCTION BY STORY

   2.00+00   2.00+00

AVERAGE CLEARANCE IN MULLIONS (INCHES)

   1.25-01   1.25-01

COEFFICIENT OF VARIATION BY STORY

   5.00-02   5.00-02

DRIFT TO YIELD BY STORY (PARTITIONS)

   4.00-03   4.00-03

COEFFICIENT OF VARIATION BY STORY

   5.00-02   5.00-02

THICKNESS OF WINDOW GLASS BY STORY (INCHES)

   1.25-01   1.25-01

MEAN BREAKING STRESS OF GLASS

   2.00+04

COEFFICIENT OF VARIATION BY STORY

   5.00-02   5.00-02
```

STRUCTURAL DAMAGE DUE TO EARTHQUAKE (PERCENT)

STORY NO.	FRAME DAMAGE	WALL DAMAGE	DIAPHRAGM DAMAGE
1	.02	.02	.02
2	.00	.00	.00

NONSTRUCTURAL DAMAGE DUE TO EARTHQUAKE (PERCENT)

STORY NO.	MMI (A)	MMI (V)	MMI (A,V)	MULLION DRIFT	NONSTR DAMAGE	GLASS DAMAGE
1	10.3	8.5	10.3	2.83-03	100.00	.00
2	9.4	7.6	9.4	1.97-03	26.82	.00

STRUCTURAL DAMAGE DUE TO WIND (PERCENT)

STORY NO.	FRAME DAMAGE	WALL DAMAGE	DIAPHRAGM DAMAGE
1	.00	.00	.00
2	.00	.00	.00

NONSTRUCTURAL DAMAGE DUE TO WIND (PERCENT)

STORY NO.	PARTITIONS DAMAGE	GLASS DAMAGE DUE TO DIRECT PRESSURE WALL 1	WALL 2	WALL 3	WALL 4	CORNERS
1	.00	.00	.00	.00	.00	86.42
2	.00	.00	.00	.00	.00	2.73

DAMAGE TO LONG-SPAN ROOF

TIE-DOWN CAPACITY AND DEAD WEIGHT CAPACITY ARE ADEQUATE TO RESIST PREDICTED LEVELS OF NET UPLIFT DUE TO WIND, AND COLLAPSE DUE TO PONDING (IF ANY). NO DAMAGE IS PREDICTED.

W I N D   R E S P O N S E   A N A L Y S I S

W I N D   D U E   T O   T O R N A D O

WIND ANALYSIS

STORY NO.	DEFLECTION (INCHES)	DRIFT (IN/IN)	STORY SHEAR (KIPS)
1	.047	.0001	75.26
2	.022	.0001	206.98

LONG SPAN ROOF ANALYSIS

```
ANALYSIS CODE . . . . .=    2
SLOPE OF ROOF . . . . .=     .00 DEGREES
ROOF UPLIFT CAPACITY   =   3.400+06 POUNDS
COLLAPSE CAPACITY . . .=   3.000+07 POUNDS
DEPTH OF PONDING  . . .=     .00 FEET
ROOF UPLIFT LOAD. . . .=  -1.329+06 POUNDS
PONDING LOAD. . . . . .=   0.000    POUNDS
```

DAMAGE ANALYSIS

STRUCTURAL DAMAGE DUE TO WIND (PERCENT)

STORY NO.	FRAME DAMAGE	WALL DAMAGE	DIAPHRAGM DAMAGE
1	.00	.00	.00
2	.00	.00	.00

NONSTRUCTURAL DAMAGE DUE TO WIND (PERCENT)

STORY NO.	PARTITIONS DAMAGE	GLASS DAMAGE DUE TO DIRECT PRESSURE WALL 1	WALL 2	WALL 3	WALL 4	CORNERS
1	.00	100.00	100.00	100.00	100.00	100.00
2	.00	100.00	100.00	100.00	100.00	100.00

DAMAGE TO LONG-SPAN ROOF

TIE-DOWN CAPACITY AND DEAD WEIGHT CAPACITY ARE ADEQUATE TO RESIST PREDICTED LEVELS OF NET UPLIFT DUE TO WIND, AND COLLAPSE DUE TO PONDING (IF ANY). NO DAMAGE IS PREDICTED.

END OF JOB.

@FIN

4.6 SUMMARY

Table 4.1 presents a general summary of the damage evaluation obtained using each of the three methods noted in chapter 3. Earthquake, wind and tornado loadings were considered. While each method presents the evaluation in a somewhat different format it is clear from table 4.1 that the general evaluation of the building is consistent.

It is not the intent of this demonstration example to compare the relative merits of the three methods. This example problem demonstrates the benefits of performing a building evaluation using all of the methods. Such an approach provides the engineer with a total insight into the problem which would not be possible if only one method were used.

Table 4.1 Summary of Evaluation for Demonstration Building

Natural Hazard	Field Evaluation Method	Approximate Analytical Method	Detailed Analytical Method
Earthquake (MMI 9.5)	Poor Structural Rating Fair Nonstructural Rating	Very Poor Structural Rating Poor Nonstructural Rating	2% Structural Damage 63% Non structural Damage
Wind (100 mph)	Fair Structural Rating Fair to Good Non-Structural Rating	Good Structural Rating No Interior Non-Structural Damage	0% Structural Damage 44% Corner Window Damage
Tornado (200 mph)	Fair Structural Rating Good Rating for Walls Poor Rating for Windows	Good Structural Rating Noted Potential for Missile Damage	0% Structural 100% Window Damage

At the present time there exists very few full scale structures which have been severely damaged during the occurrence of a natural hazard <u>and</u> have recorded building response or wind velocity data. Insight into the area of damage evaluation can only be improved as more such quantitative data are obtained. Therefore, the user must recognize not only the inherent uncertainty in his selection of values of input parameters for each of the damage evaluation methods presented, but also the uncertainty in what seismic and wind

excitation levels cause damage to different classes of buildings. To be sure, this area requires considerable research. By the working of examples of the type presented in this chapter, however, the user will gain an appreciation for what the key parameters are and what general levels of damage he can expect for a particular building. Learning of this type is a significant and essential step toward safe design.

5. SUMMARY

This report presents a methodology for evaluating the potential damage of buildings due to earthquake and extreme wind including tornado and hurricane. Three independent, but related, sets of procedures are developed. These ranged from a qualitative procedure based on field survey data to a detailed analytical procedure involving a digital computer program. Historical seismic and meteorological data are used as the basis for establishing environmental loads. Damage estimates are based on empirical correlations between structural response and observed damage coupled with engineering judgment.

The methodology presented in this report incorporated the state-of-the-practice techniques available in the engineering profession. However, it is recognized that because of the increased social and political interest in disaster mitigation in recent years, this entire area of research is in a stage of rapid development. Therefore, it is anticipated that the methodology will be periodically up-dated.

Based on experience gained in the development of this methodology, it is recommended that consideration be given to further study of the following topics to improve its further application:

1. Sensitivity Study

The present methodology incorporates many parameters from many diverse areas of engineering. Some parameters have a direct effect upon the final answer whereas the influence of other parameters is indirect and difficult to visualize. Therefore, an analytically based sensitivity study using perturbation theory concepts should be undertaken. The alternative to such a systematic sensitivity study is a parametric study involving many hundreds of problem solutions; this is inefficient and undesirable.

2. Damage Data

More structural and nonstructural damage data from future disasters will contribute greatly to the refinement of the present methodology. It is highly desirable that the data be recorded in a format which is compatible with the methodology. Thus, the data should be obtained in a systematic manner with the mechanics of the data gathering established prior to the occurrence of the natural disaster.

3. Program Module Modification

The building modeling techniques should be extended to include torsional motions. Recent full scale test data indicate that this response mode is important in both wind and earthquake excitation, and because it seems to most significantly effect floor accelerations away from the building's center of mass, it should have a significant influence upon nonstructural damage estimates. While modeling techniques for three-dimensional tier buildings are available, certain problems associated with the inclusion of a torsional modeling capability exist. They are, (i) the specification of torsional modal damping values, (ii) evaluating the distribution of damage to floors, i.e., to corners, center, etc., and (iii) generation of earthquake ground motion spectra and wind loads which reflect the characteristics of observed loading in the two perpendicular translational building motion directions.

The inclusion of a module for analyzing a building for its earthquake inelastic time dependent response should be considered. Presently, the user has the option of modifying the site spectra for ductility. The modification factors are meant to provide intelligent estimates of inelastic response without a detailed inelastic response analysis. It is recognized that such estimates are approximate. Significant problems exist in incorporating an inelastic response procedure. Among these problems are, (i) the need to generate ground displacement time histories for a site, and (ii) the characterization of acceptable analytical strain-displacement relationships (e.g., elastic-plastic, stiffness - degrading, etc.) for each of the building types noted in this report.

Finally, the quantification of uncertainties introduced at various stages of the analysis, and a systematic treatment of their combined influence on damage estimates is essential. Such an effort would not only result in a quantitative assessment of uncertainty in the damage estimates, but would point out the sensitivity of the final results to specific sources of error. A separate subprogram module could be developed to operate on the uncertainties associated with each stage of computation.

This report represents a first step in the area of damage evaluation. It should and will be modified and improved with time and experience. The modular form of the computer program was purposely designed for this reason. The importance of this report can best be appreciated by recognizing that it brings together a detailed modeling of the many areas of natural hazard damage evaluation by utilizing a systems engineering approach.

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7. ACKNOWLEDGMENTS

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APPENDIX A

DATA COLLECTION FORM

A.1 COMMENTARY ON THE USE OF DATA COLLECTION (DC) FORM

Purpose

Data Collection Form (DC-1 through DC-12) are provided for the Field Data Collection Teams. Comments on the use of this form and suggested methods of procedure are presented herein along with suggestions for equipment to be used by the team. While the data contained on these forms is not necessary for the use of the Detailed Analytical Evaluation Method it does provide significant engineering insight into the building and therefore should in general be collected.

Data Collection Teams should consist of a Team Leader who is familiar with construction and has been briefed on, or is familiar with, lateral force design principles. Other Team members hopefully will be somewhat familiar with construction methods and construction materials. In reporting on stability of equipment it is advantageous to have team members who have some experience in the mechanical and electrical fields so that equipment may be properly identified.

It is intended that the DC Form be used to obtain data for evaluation of earthquake, wind, and tornado hazard. Forms will be supplied to the team with spaces for noting the items expected to be pertinent. Only those building features which are visible are expected to be noted. It is not anticipated that this team will cut into the structure or ceilings to uncover conditions. No form can be expected to cover every conceivable building feature. Thus, notes should be made of unusual conditions not covered by the form.

Entry of buildings for the data collection should be arranged with the Building Owner or Manager and a schedule set up. Some buildings may take more or less time than anticipated, so some adjustments in schedule will probably be necessary. Experience in making the survey and filling out the forms will develop increased accuracy in scheduling. The Owner or Building Manager may know something of the history of the building, such as dates of construction or alterations. The local building code in effect at the time of design may be approximated from the date of construction. Tax records can also be searched for the date but this would usually be done by other than the Data Collection Team members.

When contact is made with the Building Owner or Manager, inquiries should be made as to availability of plans, calculations, and soil or geologic reports. Sometimes these may be available at the site. If not, it is possible that the local Building Department may have plans on file. If plans are not available elsewhere, the name of the architect, engineer, or general contractor should be ascertained. It is possible that plans can be made available through these sources. In some cases plans may not agree with "as built" construction. Change orders, additions and other alterations may have occurred. Field data are therefore essential for verification, even if plans are available.

Field Equipment

A sketch board or clipboard of suitable size for the DC Form should be available. Binoculars will be valuable for checking exterior walls of the taller buildings. A camera should be taken along for taking pictures of exterior walls and items of special interest. Each member of the team should have a small steel tape for measuring wall thicknesses, etc, and a flashlight. However, most building dimensions may be paced off or otherwise estimated. A plumb bob or a carpenter's level is useful in determining the amount of tilt in low rise buildings if some tilt is visible to the eye. A tape recorder will frequently be of considerable value in describing certain conditions for later reference.

Data Collection

The current use of the building should be noted, such as "warehouse," "industrial building," "office building," "retail store," "theater," "church," "apartment house," etc. The presence and location of any large assembly areas should be noted for the file and possible life risk evaluation.

The DC Form calls for sketches of the overall plan and elevations of exterior and interior shear walls, if any. They also call for sketching in the location of shear walls in plan. This may vary from story to story. Additional blank sheets may be required. In sketching the exterior walls, any setbacks should be noted and the presence of veneer, architectural appendages and ornamentation commented on. It should be noted if exterior walls are plastered on the outside.

Exterior Wall Characteristics

The DC Form provides space for describing the exterior walls. Whether the walls are bearing walls, non-bearing walls, curtain walls, or filler walls should be noted as well as the material of the wall and their thicknesses. In a multi-story building with masonry or concrete bearing walls, variations in the thickness of walls with the story height should be noted. Veneer and architectural appendages should be itemized.

The mortar in masonry walls may be roughly checked by digging into the joints with a knife. In some cases, it is possible that the exterior surface of the joints has been pointed up with hard cement mortar, but the rest of the joints may be soft lime mortar. Thus it may be desirable to dig into interior joints.

Data for the evaluation of the lateral force resistance of these walls is the desired. For this reason, all openings should be sketched in walls that could act as shear walls.

Shear Walls

For the purpose of this data collection, a shear wall should be defined. In any building, any masonry or concrete walls not isolated from the frame of the building will attempt to resist lateral deformations between floors and will be considered to be shear walls. If the walls are isolated so that the building may deflect parallel to the plane of the walls without requiring the walls to deflect with the building, the walls are not considered to be shear walls. Usually this isolation requires a separation on three sides with confinement at top or at sides in a direction normal to the wall. Such isolation is expected to be a rare occurrence. In light frame structures or structures without concrete floors or roofs and without masonry or concrete walls, shear walls may be composed of wood studs with wood sheathing or plaster or they may be composed of metal studs and plaster. It is emphasized that curtain or filler walls of concrete or masonry will resist lateral force shears unless isolated.

Interior Shear Walls

The comments made above relating to exterior walls apply also to interior shear walls except that there will probably be no veneer or architectural appendages. All of the openings in these walls may be difficult to determine, particularly in ceiling spaces. An effort should be made at least to scan visible ceiling spaces to determine location of holes in the walls for items such as ductwork. The location of these holes with respect to door openings below the ceiling is important information in the evaluation of these walls.

Reinforced Concrete or Masonry Walls

It is usually not possible to determine the size and spacing of reinforcing steel in these walls by field inspection. There are electronic and magnetic devices that can assist in this but it is not contemplated that such devices be used nor that any extensive cutting be done in the process of collection of data on the DC Form. The thickness of wall, the age of the wall, or the laying of units may be clues in determining whether a unit masonry wall is or is not reinforced.

Common or Party Walls

Some adjacent buildings may have one common wall which, usually, is legally described in a party wall agreement. The presence of party walls should be determined, even though there may be separate ownership, because both buildings must act together in resisting lateral forces.

Parapet Walls

Parapet walls, if not properly reinforced or braced, are possible sources of earthquake hazard, particularly when they are adjacent to a public way. Thus the height, thickness, and material of parapets should be noted as well as their location. Any special anchorage of the parapet wall to the roof system should also be noted on the DC Form.

Expansion Joints or Separation Joints

Long buildings are frequently divided by use of expansion joints to limit the effects of concrete shrinkage or creep or temperature change. Also, separation joints are frequently placed in buildings designed for earthquake resistance to insure that each unit will vibrate independently without banging the other. The location of such joints is usually visible as the joints are covered by a sliding plate or a V-shaped sheet metal device. Such joints should be located on the plan sketches and the effective width of joints noted, where this width can be determined in the field.

In structures such as schools, hospitals, shopping centers, etc., there may be covered walkways between buildings. In most cases these covered walkways may be connected to one or both buildings by a sliding joint. This should be looked for and it should be noted whether or not such joints do exist.

Nonstructural Elements

Partitions may be of many types. In large general office areas, partitions may not extend to the ceiling and are frequently moved. Other partitions which are attached to the ceiling or floor above may not be frequently moved or modified. In such cases the partitions should be stayed laterally by the ceiling or floor and the method of attachment is important. This is particularly important in the case of corridor partitions, elevator enclosures, and stairway enclosures. The method of fastening may be difficult to determine in a small ceiling space, but if available this information should be obtained. Access to ceiling spaces may be possible through access scuttles or doors to attic spaces.

Masonry partitions of hollow tile, brick or concrete block are frequently used in buildings, often where little or no attempt has been made to provide earthquake resistance. When unreinforced, such partitions may represent a hazard to life safety when subjected to a major earthquake shock. When anchored to the undersides of a structural floor or roof system they will act as shear walls until they crack up. This can also happen when such partitions are enclosed by vertical structural elements. There is a special hazard when such partitions enclose exit ways, since their collapse would make the exit way unusable.

It may not be feasible to plot the locations of all non-bearing partitions, but the location of masonry partitions enclosing corridors, elevators, and stairs should be noted. For others, sufficient data of a typical nature should be noted.

Some ceilings are applied directly to the underside of floors or roof. Some are suspended to allow space for ducts or other utilities. Some suspended ceilings use T-bars in which acoustical panels are placed loose. The method of hanging suspended ceilings, and bracing by diagonal suspended wires or other means, and the general type should be noted on the forms.

Damage and Deterioration

The presence of severe cracking in walls should be noted. An experienced engineer can determine the probable cause of such damage from the crack pattern. For instance, in wood frame structures, fine vertical cracks at multiples of stud spacing may be found which are caused by plaster shrinkage. These need not be noted. Diagonal cracks on opposite corners of openings are usually caused by differential settlement. Diagonal cracks at all corners may indicate that earthquake, wind, or other vibration was the cause. X-cracks in wall piers are a typical result of earthquake response. All large diagonal cracks and X-cracks in walls should be noted. Usually these can be sketched on the wall elevations.

It is not feasible on the DC Forms to note or plot all cracks in concrete floors. However, usually large cracks in floors should be noted. Cracks in concrete slabs on grade usually need not be noted.

Some industrial operations involve acids or steam which deteriorate concrete or wood. If there is visual evidence of this, it should be noted. Lactic acid in industries utilizing dairy products may be a cause of such damage. Wood trusses and other timber construction exposed to excess moisture or steam can deteriorate rapidly. Exposed wood trusses over an enclosed swimming pool is one example.

There may be locations where loose stone or tile veneer or an ornamental appendage has fallen off. This would indicate the presence of poor or corroded anchorage. If this condition exists over a public way, it could be a hazard to life and should be noted on the elevations.

Exposure

That portion of the DC Form devoted to "Exposure" includes terminology corresponding to ANSI-A58.1-1972 [3.2] for use in entering the ANSI wind tables. Later in the forms there is space to give the rise and span of arched roofs and the shape of gabled roofs. These are to be noted so that the hazards from internal and external wind pressure can be properly evaluated.

A.2 INSTRUCTIONS FOR COMPLETING DATA COLLECTION FORM FOR NATURAL HAZARDS EFFECTS

These letters and numbers for items shown in these instructions are those appearing on the DC Form.

A. GENERAL DATA

1. Facility Number - This is to be provided by Field Supervisor.

2. Building Name - Enter the name of the building, e.g., John Hancock Center, XYZ Elementary School, etc.

3. Address - Enter street address.

4. City - Enter city or county.

5. State - Enter the name of the state.

6. Zip Code - Enter at least the first three digits if all five digits are not known.

7. Year Built - Obtain from Building Manager or Owner, from plans, or from the corner stone or dedication plaque. It can also be obtained from Sanborn maps if they are available. If none of the above are available, estimate the year built. It is important that this item be obtained as accurately as possible.

8. Date of Major Modifications or Additions, if any - Enter date of any major modifications or additions. In cases where additions have been made, report multiple years if similar type of construction and indicate on Item 20 which part of the building corresponds to which year. Use complete separate DC Form if addition is of a different type.

9. Building Code Jurisdiction - Check appropriate square.

10. & 11. Latitude and Longitude - Enter latitude and longitude in degrees, minutes, and seconds to the nearest 30 seconds. Obtain from COE Field Offices or from U.S. Geodetic Survey maps.

12. Building Use - Enter the current use of the building. Enter also the original use of the building if the current use is different. Otherwise, enter "same." For example, a building can be designed as an apartment house and later modified for commercial use by removing partitions, etc. Such changes usually result in changes in the structural characteristics.

13. The basement is defined as the story with no single wall completely above ground. See figure A.1. Correct assessment of the number of stories above and below ground surface is important for determination of structural response. Enter the number of stories below the first floor according to the above definition. See figure A.2.

14. First Story Height - The height of the first story in some cases may be different from the stories above. It can be approximately determined as the distance between the elevation of the first floor and a point located about half way between the top of the first story window and the bottom of the second story window. If building plan is available, it can be obtained from an elevàtion view (see figure A.3).

15. Average Upper Story Height - If building plan is not available, it can be determined approximately as the distance between either the top or bottom of windows of two successive stories. See figure A.3. Special story heights should be noted.

16. Exterior of First Story - Usually the exterior treatment of the first story of a building is different from the rest of the stories (figures A.3 and A.4). In some instances it may be the same as the ones above the first story as shown in figure A.5.

17. Roof Overhang - Some buildings have roof elements projecting beyond the face of wall below. These may be ornamental cornices or other features such as shown on the upper portion of figure A.10. Note the approximate extent of such overhangs and on which side of the building this occurs.

18. Proximity to Adjacent Building - Indicate approximate distance in feet to adjacent buildings on each side, front, and rear of building surveyed.

19. Availability of Building Plan - The availability of building plans and calculations is important for possible future detailed studies. The source for obtaining these plans should be indicated.

20. Basic Building Plan -

a. The plan of the building layout at the first floor level is to be drawn to scale. Indicate appropriate scale used. Sample sketches are shown in figure A.6.

b. Location of Shear Walls, Load Bearing Partitions, Cores, and Bracing Systems - The primary function of shear walls, shear cores, and bracing systems is to resist lateral forces on the building. Both shear walls and shear cores are found in steel, concrete, and masonry (load bearing) buildings. Usually, timber buildings also have shear walls. Bracing systems, usually X or K bracing, are found in steel structures.

Shear Walls- Shear walls can be located either around the exterior perimeter of the building or in the interior as shown in figures A.6 and A.7. They usually extend from the foundation to the roof of the building. In most cases, shear walls consist of reinforced concrete, brick, or concrete block. Usually their thickness is not less than six inches. Shear walls are frequently symmetrically disposed about the geometric center of the plan. This may not be the case where the plan of a building does not possess symmetry about both axes.

Shear Core- Enclosure walls of elevator shafts or stairwells usually comprise the shear core. As such they usually extend from the building foundation to the roof. The function of the shear core is the same as the shear wall.

Bracing System- Bracing systems are mainly found in steel buildings which do not have shear walls and/or shear cores. Typical bracing system configurations are illustrated in figure A.8. The bracing system is usually found either in the exterior envelope of a building or hidden inside the elevator shaft or stairwell.

c. Location of Main Frame - Accurate location of the main load resisting frames in a building is important in the assessment of building response to lateral loads. The framing plan in both the longitudinal and transverse directions is required.

d. Expansion joints are sometimes provided in extremely long buildings to control the effect of temperature change. Also, they may be provided in buildings designed for earthquake to separate portions of a building having dissimilar vibration characteristics. The effect of expansion joints is to separate the building into separate units. In such cases the structural system of each unit may need to be rated separately.

e. The location of the streets and alleys should be noted on the overall plan with an approximate north arrow. The sides should be labeled "A," "B," "C," "D," etc., for simplifying identification at a later date.

f. Party Wall - The party wall is a wall commonly shared by two adjacent buildings. This type of wall is frequently found in older buildings.

g. Setback - Buildings are sometimes set back from the base story on one or more sides and at various levels. If this occurs, more than one plan will need to be sketched. This may also be shown on the elevations of exterior walls under Item 21.

21. Elevation of Exterior Walls - It is not uncommon to find openings in shear walls for windows and corridors (figures A.9a and A.9c). These openings may weaken the walls, causing them to sustain serious damage as illustrated in figure A.9b. In some cases, total collapse of a building could result from weakened shear walls. Therefore an accurate assessment of openings in the shear walls is one of the important items in the survey. For load-bearing structures, locations of shear walls are not apparent. In this case, all solid walls are to be considered as shear walls. A simple line sketch as shown in figure A.9c is required for each shear wall. The sketch should indicate as close to the true proportion as possible all openings in the walls from the lowermost story of a building to the roof. If the shear walls do not extend continuously from the foundation to the roof, points of termination should be indicated.

a. In sketching the elevations of the exterior walls, we need to note the openings and their approximate size and spacing. Those portions of wall between openings may be potential shear walls. If the pattern of openings is repetitive, all of the openings on a repetitive series need not be shown. The first two and the last two will normally be sufficient.

b. The exterior walls may be faced with a veneer or cladding, or may be concrete or masonry plastered on the outside. This should be noted on the elevations as well as the presence of appendages such as ornamental cornices, balconies, gargoyles, etc.

c. The material of the exterior walls should be noted. They may be concrete, masonry, metal studs and plaster, wood studs and plaster, or all glass. If veneered or plastered, the material of the walls may not be evident from the inside or the outside. In such cases, tapping the wall with a small solid object will help to determine whether the wall is hollow block, solid grouted block, solid concrete or brick, or studs and plaster. Reinforcement in masonry or concrete walls is not discernable from the surface and such information can only be obtained from the plans.

d. Major cracks or other damage should be noted on the elevations. Cracks larger at one end than the other should be noted, since this may be a clue to the cause of the crack. Other damage includes extensive spalling or weather deterioration.

e. If there is evidence of past damage repair, this should be noted.

f. If there is evidence that appendages have fallen off or have been loosened, or other cladding such as veneer or sheet metal facing has been cracked or otherwise damaged, such items should be noted on the elevations.

22. Interior Shear Walls - Shear walls to be either interior or exterior. In Item 21, instructions for sketching elevations of exterior walls have been given. Interior shear walls are usually the permanent walls around stairway and elevator shafts or the corridor walls. They may be composed of reinforced concrete or masonry. In wood frame buildings they may be made of wood studs with wood or plywood sheathing or of metal studs and plaster or wallboard. All masonry or concrete interior walls should be noted whether reinforced or unreinforced.

a. All openings in these walls should be sketched with approximate sizes.

b. As in exterior walls, the presence and location of major cracks should be noted. Whether or not a crack is wider at one end or the other is a clue to the cause of the crack, so this should be noted on the sketch.

c. If there is evidence of past damage repair, this should be noted.

23. Basement Shelter - A basement is a potential storm shelter if properly protected by a heavy concrete first floor slab.

a. Note whether the floor over the basement is concrete or other by checking the appropriate box.

b. If the floor above is concrete, note the approximate thickness. If concrete joists are used, give the depth and spacing of joists. The weight of this slab is important in resisting uplift pressures from high winds or tornadoes.

c. As a potential shelter, it is important to know how many people can be sheltered for a short time period. For this the space available is required. Sometimes a basement is used to house equipment or to store materials. If so, only the remaining space is available. This available space should be estimated in square feet.

d. Some basements may house dangerous equipment or highly flammable materials. Such a condition should be noted, since this could make the basement unsuitable for a storm shelter.

24. Vault-Like Structure - If this building has a length-width ratio, and a height-width ratio of 2 or under, exterior walls of reinforced concrete or reinforced masonry and a poured-in-place reinforced concrete roof, and if the opening in any wall or in the roof do not exceed 15% of the wall or roof area, check the box marked "Yes." If the building does not conform to this, check the box marked "No."

25. Exterior Wall Summary Sheet - From the description of the exterior walls, some estimate can be made of the age of structure and the type of framing. A typical example of the exterior wall treatment which falls in the category of "extensive architectural ornaments" is shown in figure A.10. The different between running and stacked bond masonry construction is illustrated in figure A.11.

    The condition of the wall should indicate:

    For concrete wall:

    - Whether or not reinforcing bars are exposed.
    - Spalling of concrete, if any.
    - Cracks, if any.

    For Masonry wall:

    - Condition of masonry unit, i.e., whether or not cracks appear on the surface (see figure A.12).
    - Condition of mortar - In order to determine this item, rubbing or scratching (about 1/2") is needed to see whether the mortar crumbles or not.

    The thickness of the wall can be determined by measuring the width of the wall at window or door openings.

B. SITE RELATED INFORMATION

1. Exposure - Check one of the six categories which closely approximates the surrounding conditions.

2. Topography - Enter one of the three ground features surrounding the building. Estimate the rise of the slope on the base of 12. For example, one on twelve (i.e., 1:12) etc.

3. Geologic Formation - The field supervisor should check as to availability of information on the site geology. This can usually be obtained from governmental sources. Geological maps for the entire area may be available.

4. Location of Known Faults - Enter in order of proximity the major active faults in the vicinity of the site of the building being surveyed. If a building is located in a region where a network of faults exists, list the three major active faults within a 100 mile radius from the site. Information on fault locations and whether faults are active or dormant can be obtained from state maps prepared by the U. S. Geological Survey. These maps are available from the USGS Libraries located at Menlo Park, California; Denver, Colorado; and Washington, D.C. These maps are also usually on file in offices of the Division or Department of Geology in each state.

5. Depth of Water Table - Enter number of feet. This information can be obtained from building plan or from a local structural or soils engineering office.

6. Depth of Bedrock - Enter number of feet. This information can be obtained from building plan or from a local soils engineering office.

7. & 8. Soil Type and Bearing Capacity - Information regarding these items can be obtained from building plan or from a local soils engineering office.

9. Wind Blown Debris - Potential wind blown debris from outside the building should be noted, where it can be observed by a look around the facility to be evaluated. Material such as lumber, junk yards, piles of sand or gravel are potential missiles in a tornado or other windstorm. Light sheds may be wind transported. Even gravel blown from adjoining roofs can cause damage. The presence of any material that is such a potential hazard should be noted with approximate locations and distance. Investigation of this, from a practical standpoint is limited to a distance of 100 yards from the building in urban built-up areas and the area within view of the facility in open or rural areas.

C. STRUCTURAL SYSTEMS

1. & 2. Material and Vertical Load Resisting Systems - The material used for the mainload carrying members. For example, for frame structures, identify whether beams and columns are made of concrete, steel, or timber. For load-bearing structures, identify whether the wall is made of concrete or masonry. Care must be exercised in determining this entry. Frequently, frame structures have brick-veneer cladding as shown in figure A.13a. These structures appear as masonry load-bearing structures. However, a large number of openings in the wall in all four elevations could serve as a clue that these walls cannot be load-bearing walls. It is apparent from Figure A.13b that the building is a concrete frame structure. A clue for load-bearing structures is that while a building may have many window openings, some portions of the wall which carries the vertical load must be solid and usually extend continuously through the height of the structure as shown in figure A.14. Unless a building has metal curtain walls, the exterior appearance does not usually lend itself to identifying whether the structure is made of steel or concrete. Correct identification can be made only when observations are made of exposed frames as shown in figure A.15.

3. Lateral Load Resisting System - Refer to description given for Items 20, 21, 23, and 24.

4. Floor System - Common floor systems used in engineering buildings are illustrated in figures A.16 through A.21. Unless the underside of the floor is exposed for visual examination, it is necessary to examine the space between the ceiling and the bottom of the floor above to determine types of framing and decking. For the suspended ceiling with acoustical tiles, this can easily be accomplished by lifting one of the tiles and examining the underside of the floor. For the suspended ceiling with lath and plaster, an examination can be made through inspecting openings which are usually provided in the ceiling for checking utility systems.

Connections - Unless it is a steel frame structure, the types of structural connections used are difficult to determine. For concrete frame structures, monolithic connections are used. For steel frame structures, one of the three connections illustrated in figure A.22 can be expected. They are riveted, bolted, and welded connections. Some connections use combinations of these fastening techniques as illustrated in figure A.23.

Anchorage - The anchorage of floors to walls (either bearing walls or shear) walls is to be noted. The anchorage between cast-in-place concrete floors and walls is usually satisfactory but cannot be checked by visual observation. The anchorage of metal decks to steel frame elements of walls is usually through welds or screws which cannot be seen in the completed structure. Metal decks with concrete topping slabs may have dowels extending into masonry or concrete walls, but here again these cannot be seen by the field team. If plans are available, the type and spacing of anchors should be shown.

In cases where there is a wood floor and no ceiling, some types of anchors may be visible and the type and spacing noted. Similarly, where no ceilings occur or where there is sufficient crawl space above the ceiling, the anchorage of steel frame members to the walls may be seen and noted. Even in such cases that portion of the anchors embedded in the walls cannot be seen. Figure A.19 shows a typical open web joist anchor detail.

If the type and spacing of anchorage can be determined, either from observation or from plans, fill in the appropriate box. A small sketch at the side may help describe the type. If the anchorage type and spacing cannot be determined from either observation or plans, mark "unknown" under the anchorage item.

5. Roof System - Structural framing system of the roof is usually essentially the same as the floor system. Instead of a flooring surface consisting of concrete, the roof usually has rigid insulation boards as illustrated in figures A.24 and A.25. Similar to the case of the floor, the roof framing has to be determined from the story below through the ceiling. It is probable that the same types of connection details are used for the roof framing members as for the floor framing members.

The same comments and instructions given for Floor System anchorage are applicable to Roof System anchorage.

D. NONSTRUCTURAL ELEMENTS

1. Partition (non-load bearing) - In concrete or steel frame structures, non-load bearing interior partitions are not designed to resist any loads, either vertical or horizontal. However, when structures having masonry partitions are subjected to lateral forces, these partitions participate in resisting lateral forces together with the structural frame. Such partitions may change the structural response characteristics to such an extent that the structure either sustains severe damage or reaches a state of collapse. These partitions, also called "infill walls," are usually made of brick, concrete block, clay tile and gypsum wallboard partitions. Gentle tapping of a partition with a solid object helps to identify the gypsum wallboard partitions from the rest. This tapping technique can also be used to identify lath and plaster on studs.

2. Ceiling - The most common materials used for ceiling include acoustical tiles, gypsum board, and plaster. Acoustical tiles and plaster on lath are usually used in commercial buildings, whereas gypsum boards are commonly used in residential-type structures such as apartments, dormitories, etc. Both acoustical tile and lath and plaster ceilings are either attached directly to the structural members or suspended from them, while gypsum board ceilings are directly attached to structural members. The typical appearance of acoustical tile ceilings is shown in figure A.26. Directly attached and suspended acoustical tile ceilings are illustrated in figure A.27 and lath and plaster ceilings in figure A.28.

3. Light Fixtures - Check one of the three methods which describe the fixture attachment (see figure A.29). This should be done separately for the typical room and corridor.

4. Mechanical Equipment - Enter the location of the mechanical equipment room. Examine whether or not heavy equipment, such as motor, pump, generator, etc., is securely attached to the floor. Usually the supporting legs of heavy equipment are anchored to the floor by means of anchor bolts. If anchor bolts are not found, it is assumed that the equipment is not fastened to the floor.

   Indicate where the water tank, cooling tower, and air conditioning units are located and examine whether or not these items are securely anchored.

5. Roofing - Indicate the slope of the roof. If flat, simply indicate by checking the appropriate box. If the roof has a slope, estimate the vertical rise per foot. If gravel is placed on the roof, gravel stops are usually used instead of a parapet (see figure A.30). The height of the parapet if present is to be measured as illustrated in figure A.31. Examine whether or not the parapet is anchored to the roof by means of anchor straps (figure A.32 or by other means).

6. Windows - The windows can be categorized broadly as fixed windows and movable windows. Fixed windows are those which cannot be opened. Usually these windows have a large single pane of glass. Movable windows are those which can be opened as illustrated in figure A.33. Frames for both fixed and movable windows are made of different material. Check one of the materials indicated.

   The sizes of casing and glazing are illustrated in figure A.34. If more than one type of window of each category is used, select the predominant one to measure the size.

   The method of attachment of the casing to the structure is seldom apparent from a cursory inspection. Unless the method of attachment can be obtained readily by visual inspection, enter "unknown."

   The glazing is usually placed in the window casing by means of an elastometric gasket or glazing compound.

7. Gas Connections - In areas subjected to severe earthquakes, a type of gas connection has been developed which permits the building to vibrate independently from the gas line so as not to break the gas line. These connections utilize flexible connections and may have an automatic shut-off valve. Such a connection will usually be before the gas meter but adjacent to the building and may be in a pit or in a box or may be buried. The type of connection may or may not be visible for inspection but the building manager may know whether or not an earthquake resistant connection has been provided. Some buildings, of course, may be all electric and use no gas. If so, this should be noted by a check in the "none" box.

A.3 DATA COLLECTION FORM

The remaining pages of this appendix present the data collection form used in this methodology.

DATA COLLECTION FORM
NATURAL HAZARDS EFFECTS
(Extreme Winds, Earthquakes)

A. GENERAL DATA

*1. Facility No. ________ 2. Building Name ______________________________

3. Address ____________________________________ 4. City __________________

5. State ____________________ 6. Zip Code _______ 7. Year Built _______

8. Date of Major Modifications or Additions, if any ________________________

9. Building Code Jurisdiction: City ☐ County ☐ State ☐ Federal ☐

*10. Latitude ________________________ *11. Longitude ______________________

12. Current Bldg. Use ____________ Orig. Bldg. Use ______________________

13. Basement Yes ____ No ____ Number of Basements ________________

No. of Stories Above Basement _______________ (See also Item A23)

14. Height of First Story __________________ ft.

15. Upper Story Height ____________ ft. Special Story Height _________ ft.

16. Is the exterior of first story different from upper stories?

Street Front Side Yes ____ No ____ Other Sides Yes ____ No ____

17. Approximate Roof Overhang Distance ____________ Side ________________

18. Proximity to Adjacent Buildings: Sketch Below with North Arrow

North Side _______ South Side _______ East Side _______ West Side ______

Note Street or Alley Sides ____

*To be filled in by Field Supervisor.

Sketch

19. Are plans available? ______ If so, where obtainable ____________________

____________________ Are original calculations available? ______ If so,

where obtainable ____

Name of: Architect ____________________ Engineer ____________________

Contractor ____

Regulatory Agency ____

20. Basic Building Plan

a. Sketch overall plan.
b. Locate shear walls, if any.
c. Locate main frames.
d. Locate expansion joints, if any.
e. Give approximate north arrow and label sides "A", "B", "C", "D", etc. Show street or alley sides.
f. Note any common or party walls.
g. If plan changes in upper floors, sketch this plan and note level of change.

(Use additional sheet if necessary)

21. Elevation of Exterior Walls.

Sketch:
a. All openings or note pattern of openings.
b. Note exterior finish and appendages.
c. Note material of walls.
d. Major cracks or other damage. (Note if cracks are larger at one end.)
e. Note previously repaired damage.
f. Note any evidence of damage to cladding or appendages.

(Use additional sheet if necessary)

22. Elevation of Interior Shear Walls.

Sketch:
a. All openings.
b. Major cracks or other damage. (Note if cracks are larger at one end.)
c. Note any previously repaired damage.

23. Adaptability of Basement to Storm Shelter.

   a. Floor Over Basement - Concrete ☐ Other ☐

   b. If concrete, give thickness ________

   c. Available Space (approximate) ______________ sq. ft.

   d. Dangerous Contents. Storage of Flammable Liquids ☐

   Presence of Transformers or Other Dangerous Equipment ☐

   Other Hazards ____

   None ☐

24. Is this a Vault-like Structure? Yes ☐ No ☐

25. EXTERIOR WALL SUMMARY SHEET

Exterior Characteristics	Side A	Side B	Side C	Side D
Extensive Architectural Ornaments or Veneer				
WALLS Metal Curtain Wall				
Precast Concrete Curtain Wall				
Stone				
Brick				
Concrete Block				
Concrete				
Other				
For Concrete Block and Brick, indicate R for Running Bond S for Stacked Bond				
Condition of Wall*				
OPENINGS Percent of Open Area per Story				

*1. No cracks, good mortar.
2. Few visible cracks.
3. Many cracks
4. Evidence of minor repairs.
5. Evidence of many repairs.

B. SITE RELATED INFORMATION

1. Exposure

   a. Centers of large city ☐ b. Very rough hilly terrain ☐

   c. Suburban areas, towns, city outskirts, wood areas, or rolling terrain ☐ d. Flat, open country ☐

   e. Flat coastal belts ☐ f. Other ☐

2. Topography

   a. Building on level ground ☐ b. Building on sloping ground ☐

   c. Building located adjacent to embankment ☐

*3. Geologic formation ____________________

*4. Location of known faults: Name ____________________ Miles ______

____________________ Miles ______

*5. Depth of water table ________ ft. When measured: ____________________
(Month) (Year)

*6. Depth of bedrock ____________ft.

*7. Soil type ____________________

*8. Bearing capacity ____________ p.s.f., or ____________ blows per inch

9. Proximity to potential wind-blown debris - Type ____________________

   Location ____________________ Distance ____________

*To be filled in by Field Supervisor.

C. STRUCTURAL SYSTEMS

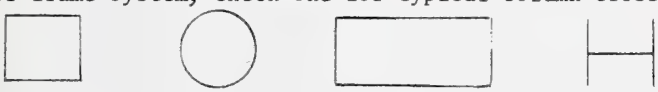
1. Material

   Concrete ☐ Masonry ☐ Steel ☐ Wood ☐

2. Vertical Load Resisting System

   Frame ☐ Bearing Wall ☐ Wall and Pilasters ☐

   For frame system, check one for typical column cross-section



☐ ☐ ☐ ☐ Other ☐

3. Lateral Load Resisting System

   Masonry Shear Wall ☐

   Concrete Shear Wall ☐

   Plywood Shear Wall ☐

   Braced Frame ☐

   Moment Resisting Frame ☐

   Are resisting systems symmetrically located? ☐ Yes ☐ No

4. Floor System

   Frame

   Concrete Beams ☐

   Steel Beams ☐

   Steel Bar Joist ☐

   Wood Beams ☐

   No Framing Members ☐

   Precast Concrete Beams ☐

   Deck

   Concrete Flat Plate ☐

   Concrete Flat Slab ☐

   Concrete Waffle Slab ☐

   Steel Deck ☐

   Wood Joists ☐

   Wood Plank ☐

   Straight Sheathing ☐

   Plywood Sheathing ☐

   Diagonal Sheathing ☐

   Precast Concrete Deck ☐

   Concrete Joists ☐

   Concrete Plank ☐

   Note if concrete topping slab is used over metal decks or concrete plank.

Connection Details

	Framing	Decking To Framing
Bolted	☐	☐
Welded	☐	☐
Metal Clips	☐	☐
Wire Fastener	☐	☐
No Connection	☐	☐
Nailed	☐	☐
Metal Hangers	☐	☐

Anchorage Floor to Walls

Type ____________________

Spacing ____________________

5. Roof System

Frame

Concrete Beams	☐	Steel Truss	☐
Steel Beams	☐	Wood Truss	☐
Steel Bar Joist	☐	No Framing Members	☐
Wood Beams	☐	Precast Concrete Beams or Tees	☐
Wood Rafters	☐		

Deck

Concrete Flat Slab	☐	Concrete Waffle Slab	☐
Metal Decking	☐	Plywood Sheathing	☐
Concrete Slab	☐	Diagonal Sheathing	☐
Concrete Joists	☐	Straight Sheathing	☐
Precast Decking	☐	Concrete Fill	Yes ☐ No ☐

Connection Details

	Framing	Decking to Framing
Bolted		
Welded		
Metal Clips		
Wire Fastener		
No Connection		
Nailed		
Metal Hangers		

Anchorage Roof to Walls

Type ______________________________

Spacing ______________________________

D. NONSTRUCTURAL ELEMENTS

1. Partitions

Type

	Typical	Corridor
Partial Height		
Full Height Floor-To-Ceiling		
Floor To Floor		
Movable		

Composition

Lath and Plaster	
Gypsum Wallboard	
Concrete Block	
Clay Tile	
Metal Partitions	

2. Ceiling

Typical Room

Material

Acoustical Tile [ ] Gypsum Board [ ] Plaster [ ]

Method of Attachment

Suspended [ ] Metal Channels [ ] Tee Bar Grid [ ]

Attached Directly to Structural Elements [ ]

Typical Corridor

Material

Acoustical Tile [ ] Gypsum Board [ ] Plaster [ ]

Method of Attachment

Suspended [ ] Metal Channels [ ] Tee Bar Grid [ ]

Attached Directly to Structural Elements [ ]

3. Light Fixtures

Typical Room

Recessed [ ] Surface Mounted [ ] Pendant (Suspended) [ ]

Typical Corridor

Recessed [ ] Surface Mounted [ ] Pendant (Suspended) [ ]

4. Mechanical Equipment

Location of Mechanical Equipment Room

Basement [ ] Other Floor [ ] Which Floor ________

Roof [ ]

Is Equipment Anchored to Floor? No [ ] Yes [ ]

Location of The Following Units

Liquid Storage Tank ____

Cooling Tower ____

Air Conditioning Unit ____

5. Roofing

Description

Flat ☐ Arched ☐ Gabled ☐ If arched or gabled, sketch section.

Pitched ☐ Slope (:12)

Parapet No ☐ Yes ☐ Height (______ ft. _____in.) Thickness (_____in.)

Material ______________ Special Anchorage or Bracing Yes ☐ No ☐

Type

Built-up gravel ☐ Gravel ☐ Asphalt or Wood Shingles ☐

Clay Tile ☐ Other ☐

6. Windows

Type

Fixed ☐ Movable ☐

Frame Material:

Aluminum ☐ Steel ☐ Stainless Steel ☐ Wood ☐

Size: Average Size of Casing (____ ft. x _____ ft.)

Average Size of Glazing (____ ft. ____ in. x ____ ft. ____ in.)

How Casing is Attached to Structure

Bolted ☐ Screwed ☐ Clipped ☐ Welded ☐ Nailed ☐

Glazing Attachment to Casing

Elastomeric Gasket ☐ Glazing Bead ☐ Aluminum or Steel Retainer ☐

Other ☐

7. Gas Connection

Flexible Connection to Building ☐ Rigid Connection to Building ☐

Automatic Shut-off ☐ None ☐ Unknown ☐

INSPECTED BY ________________________________

DATE ____________________________________

FIELD SUPERVISOR ____________________________

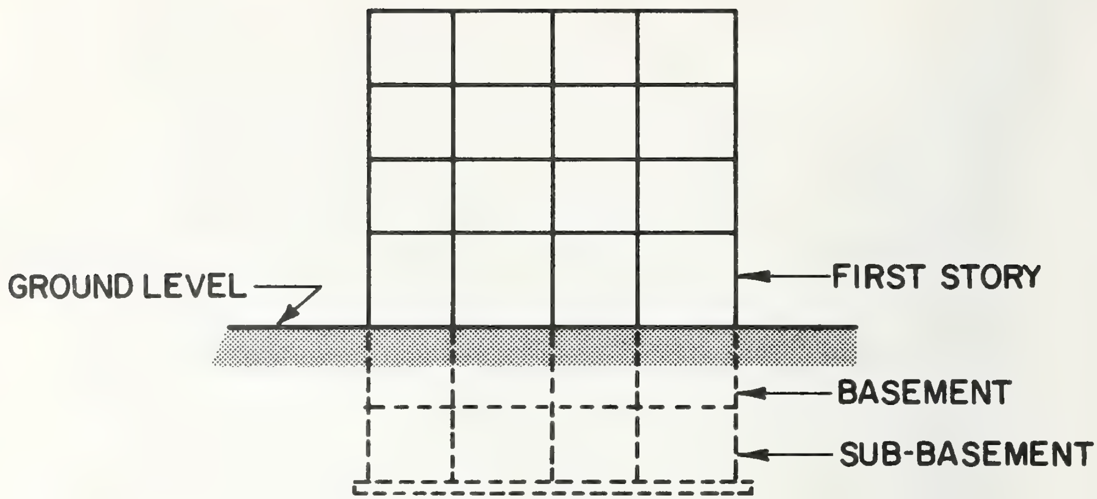


Figure A.1

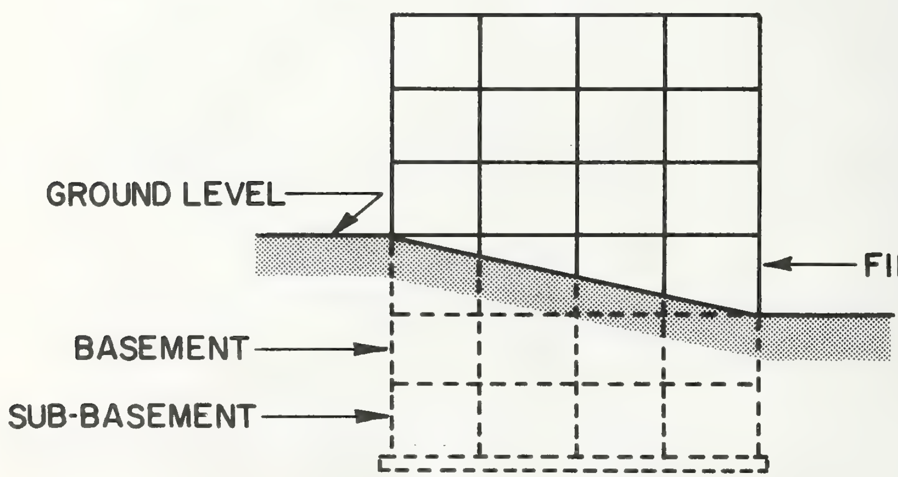


Figure A.2

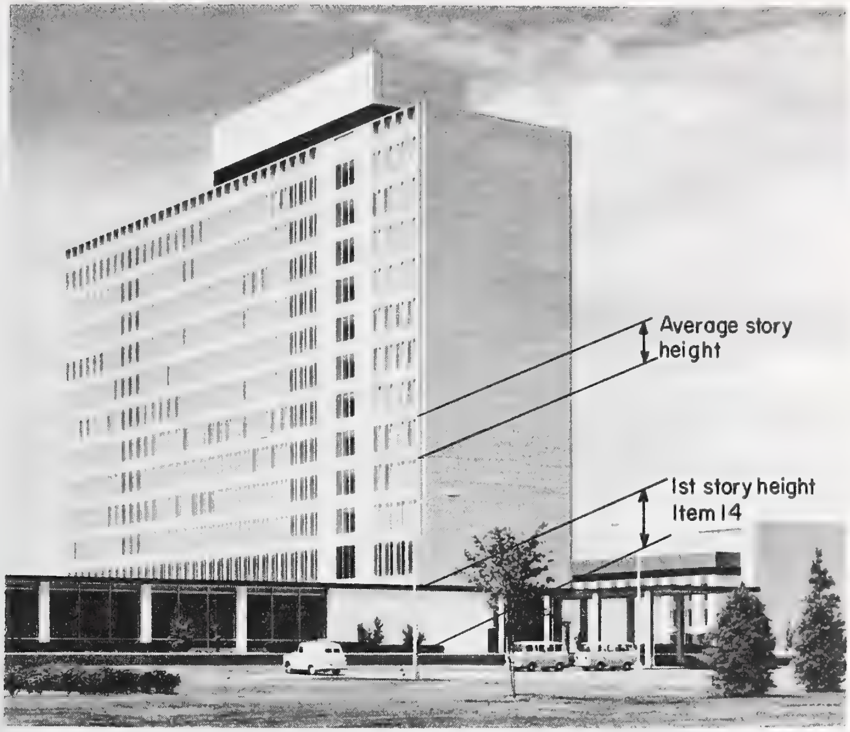


Figure A.3

Figure A.4

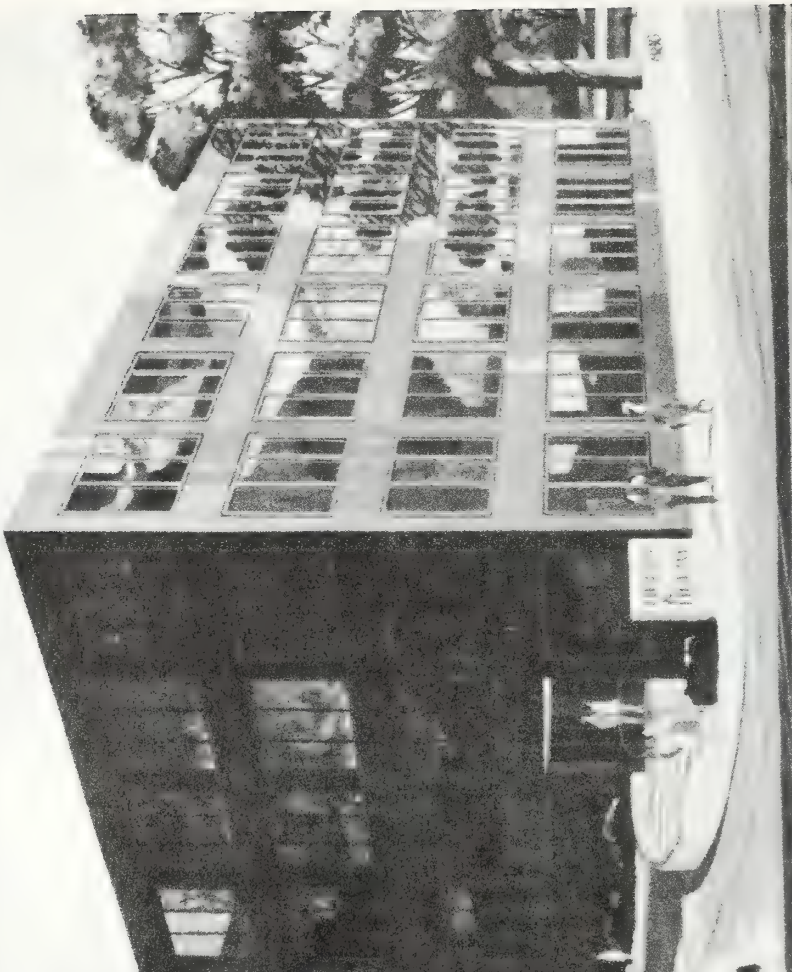
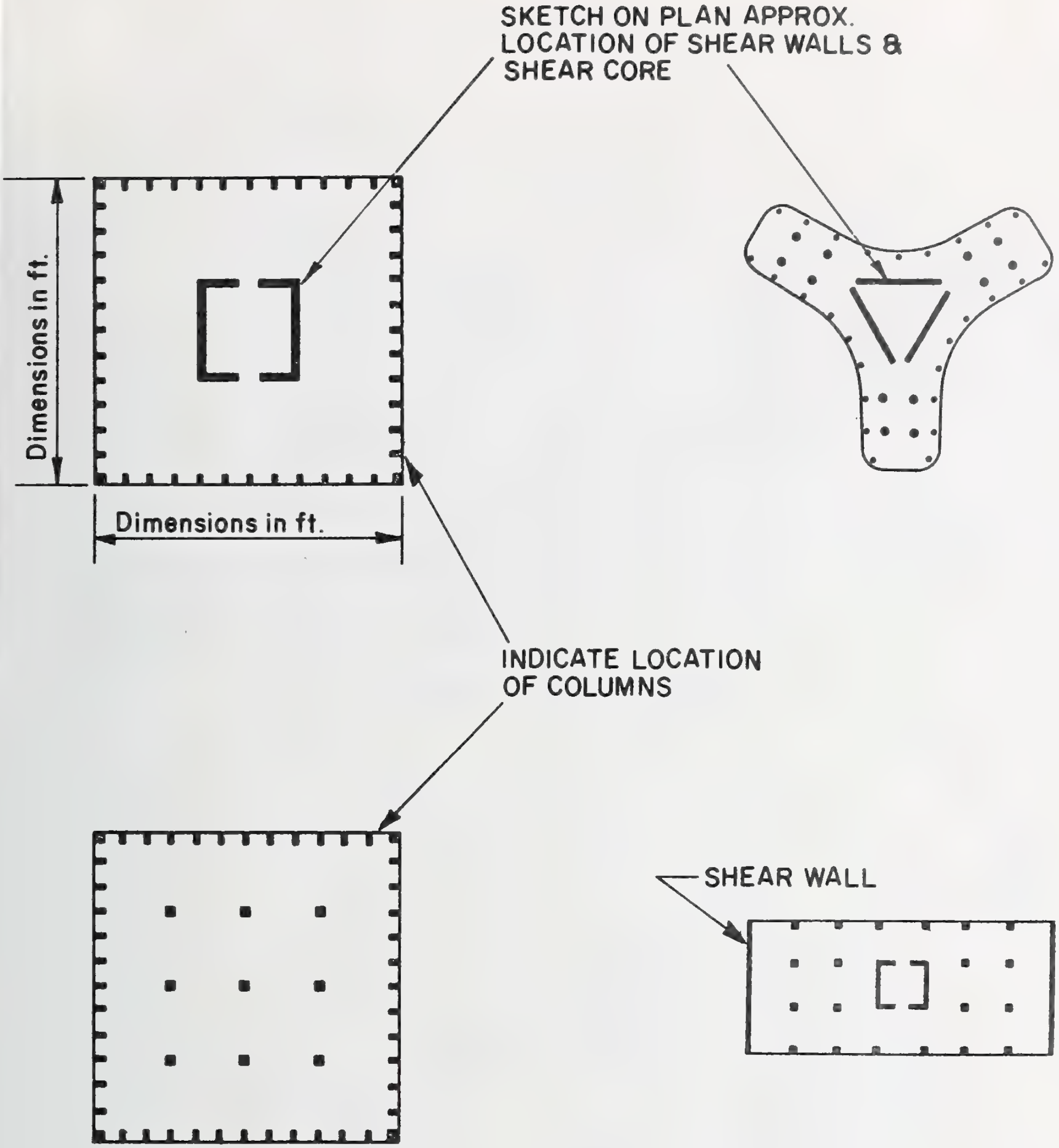


Figure A.5



INDICATE ON PLAN WHETHER THE SHEAR WALL AND CORE ARE REINFORCED CONCRETE OR MASONRY

Figure A.6

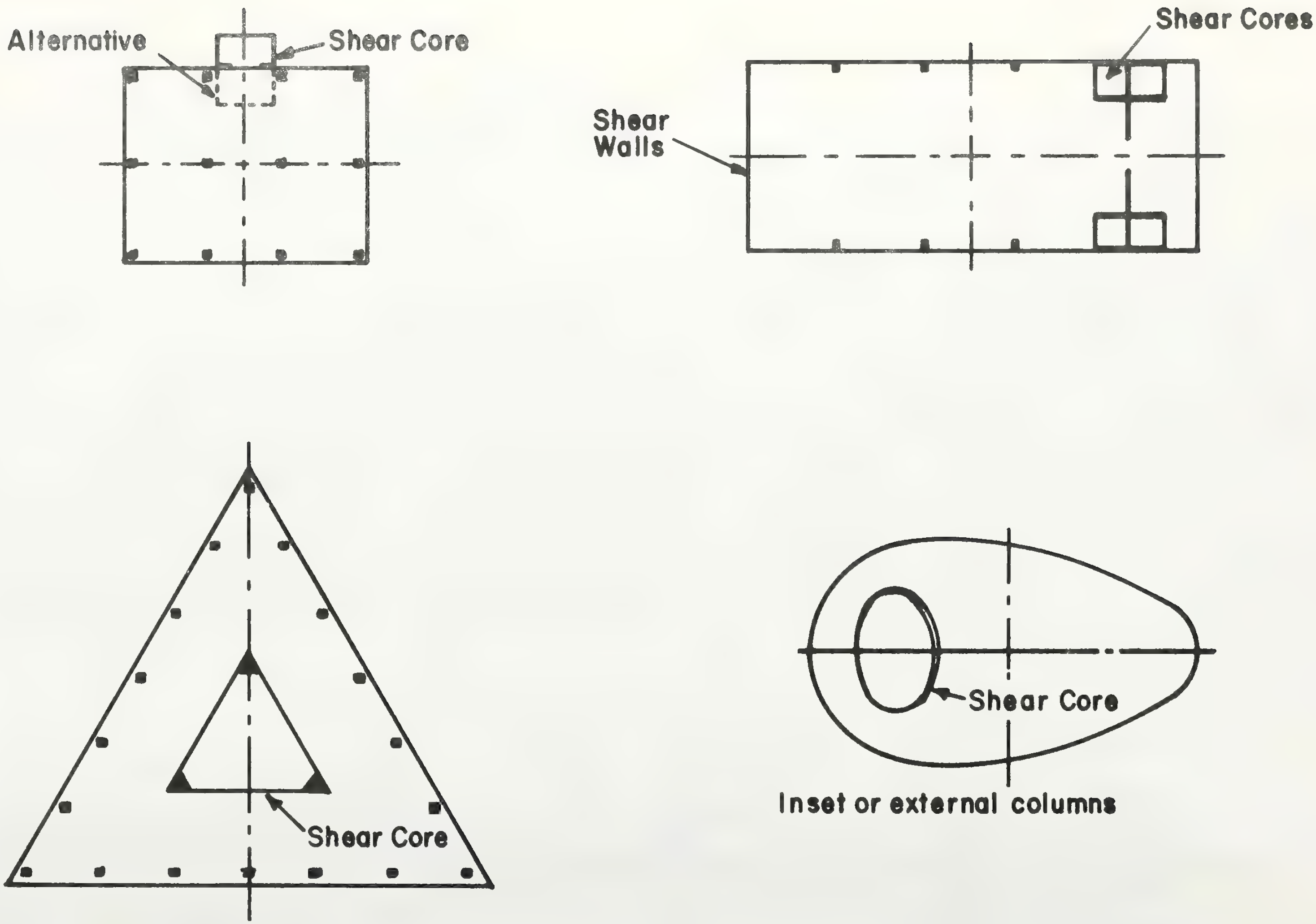
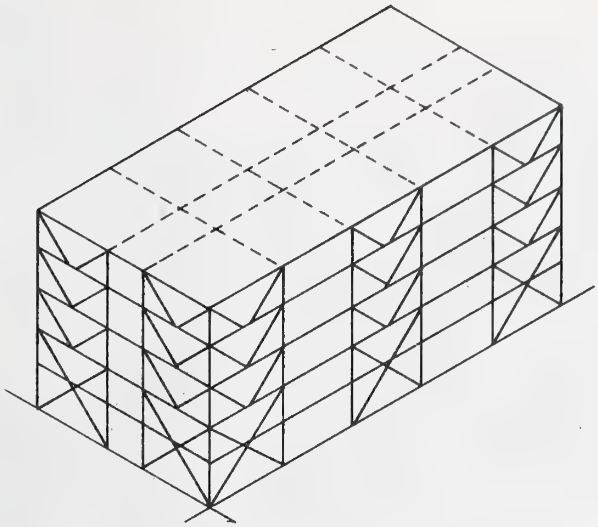
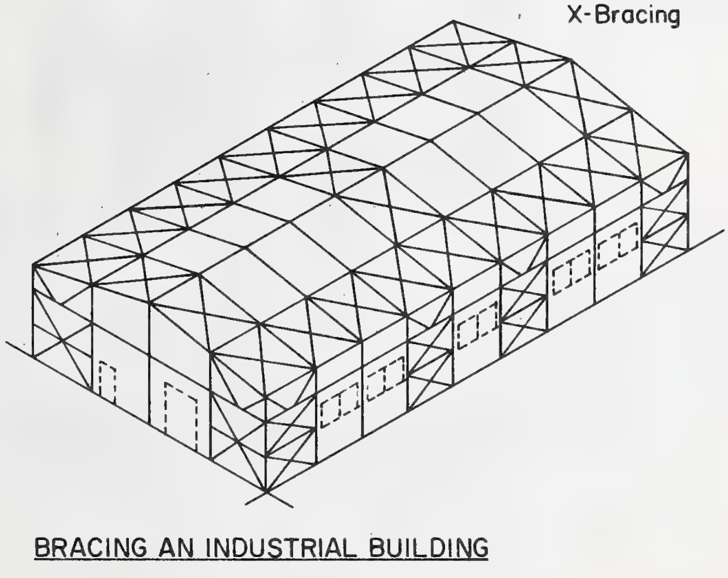

Alternative
Shear Core
Shear Cores
Shear
Walls
Shear Core
Shear Core
Inset or external columns

Figure A.7

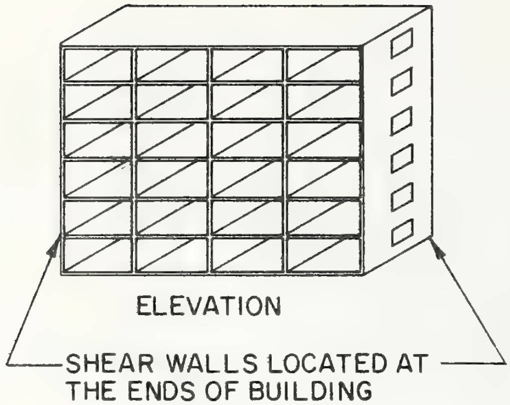


BRACING FOR A TIER BUILDING

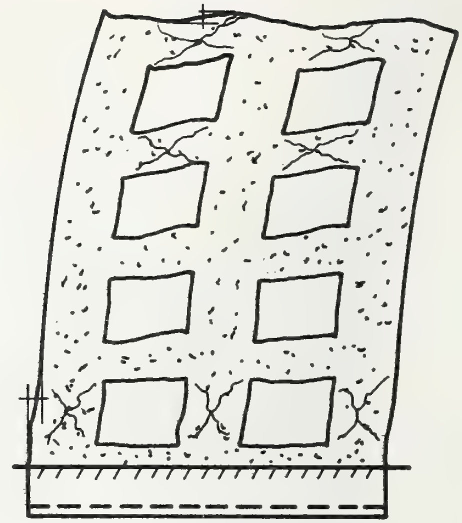


BRACING AN INDUSTRIAL BUILDING

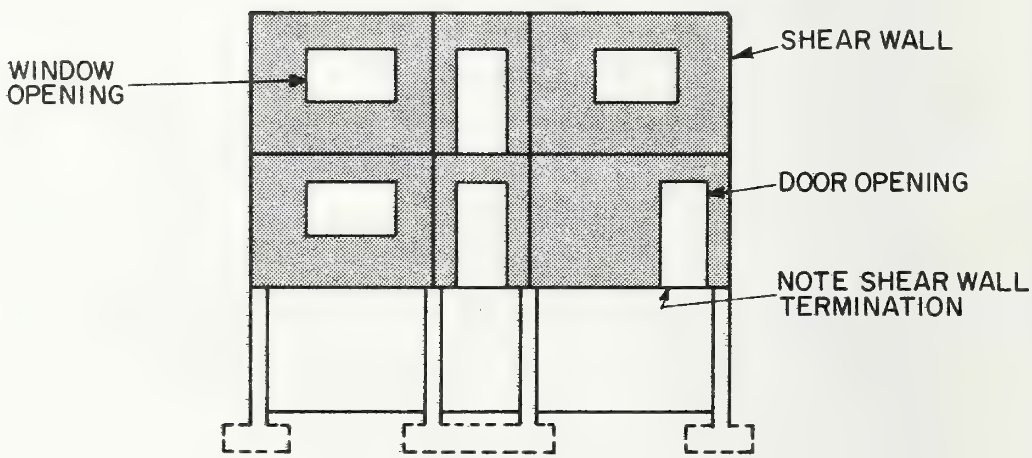
Figure A.8



(a)



(b) DEFORMATION OF SHEAR WALL WITH OPENINGS



(c) TYPICAL SKETCH OF SHEAR WALL ELEVATION WITH DOOR AND WINDOW OPENINGS

THIS TYPE OF SKETCH IS REQUIRED FOR ITEM A.

Figure A.9

Figure A.10

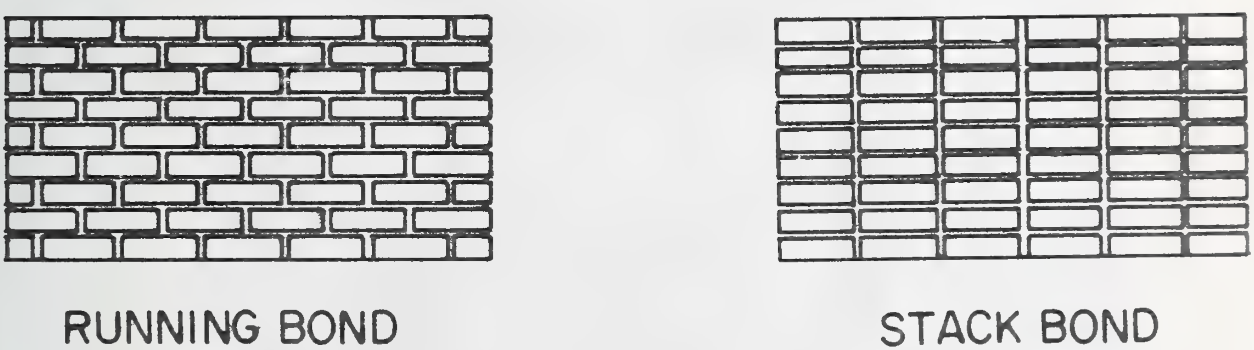


Figure A.11

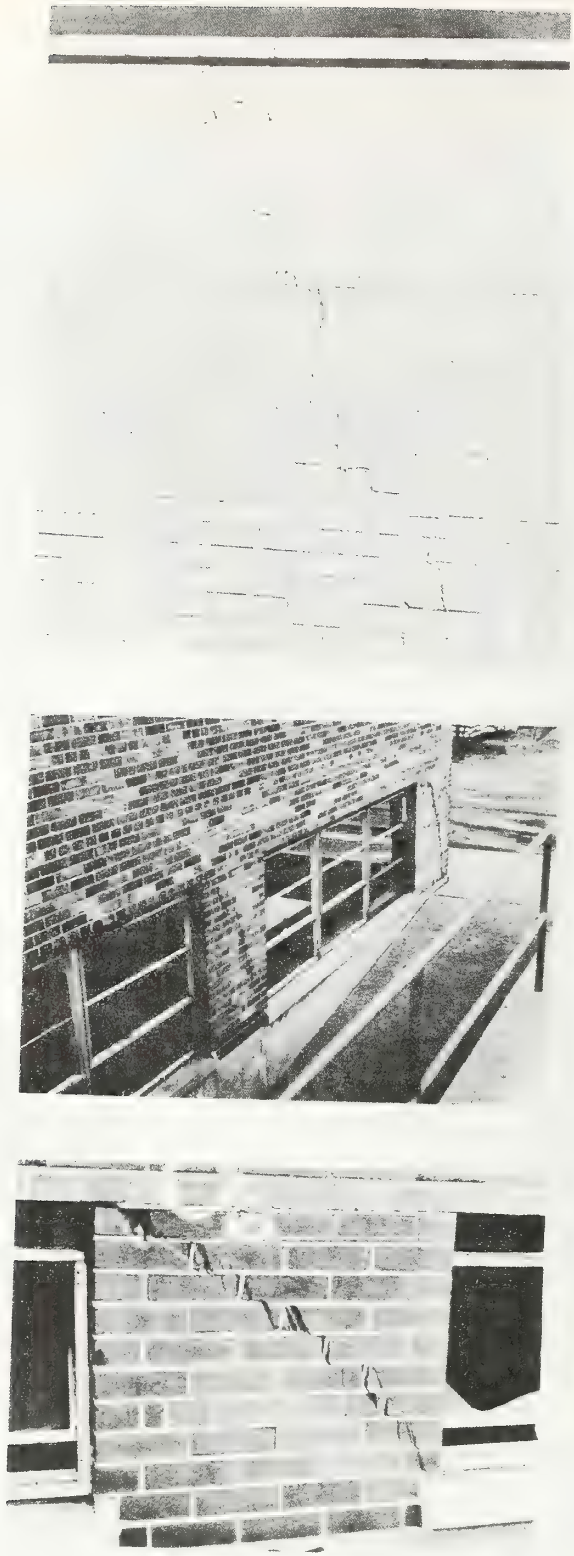
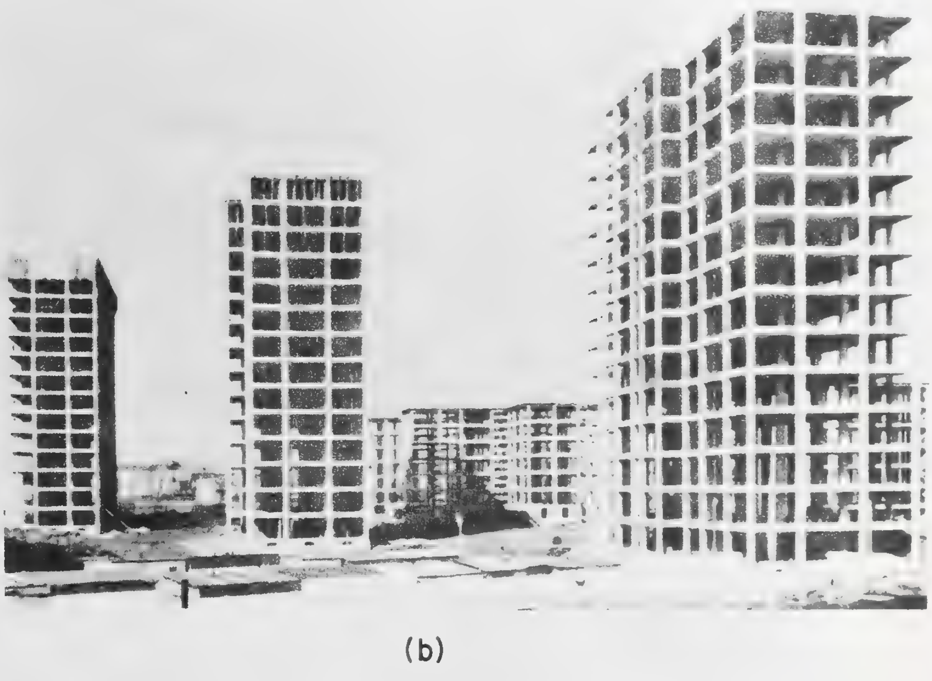


Figure A.12

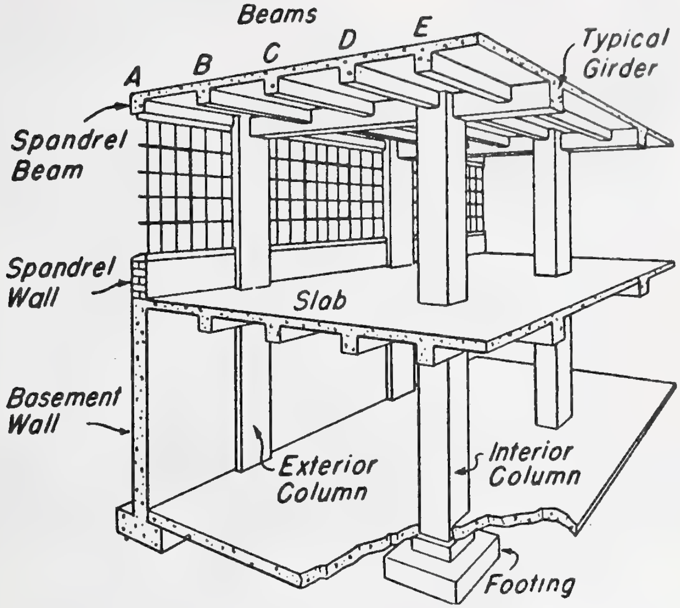
(a)



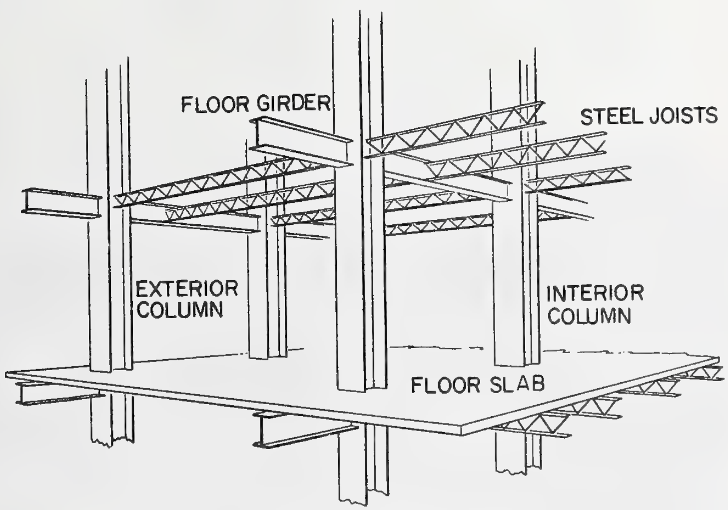
(b)

Figure A.13

Figure A.14

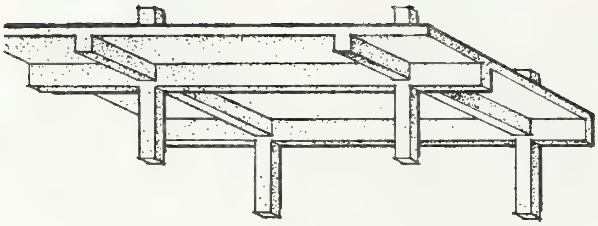


(a) CONCRETE FRAME STRUCTURE

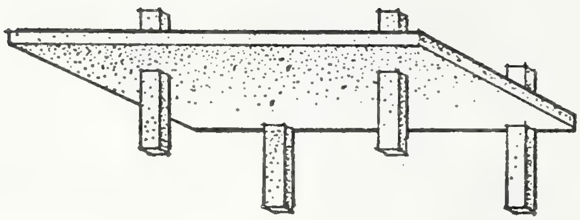


(b) STEEL FRAME STRUCTURE

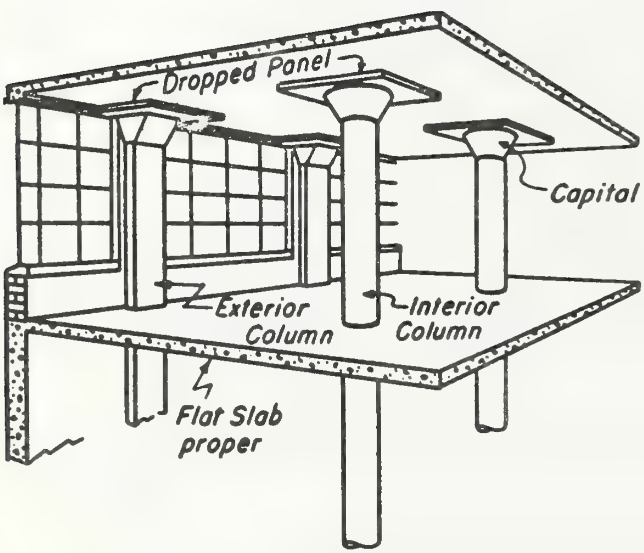
Figure A.15



CONCRETE BEAMS; GIRDERS AND SLAB SYSTEM



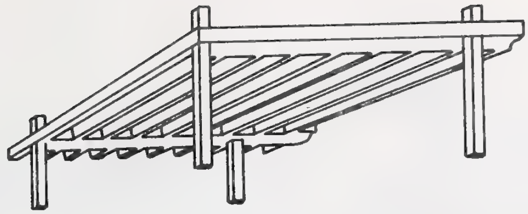
FLAT PLATE CONSTRUCTION



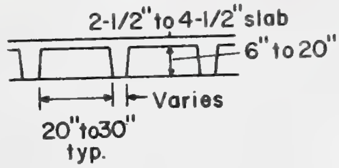
FLAT SLAB CONSTRUCTION

Figure A.16

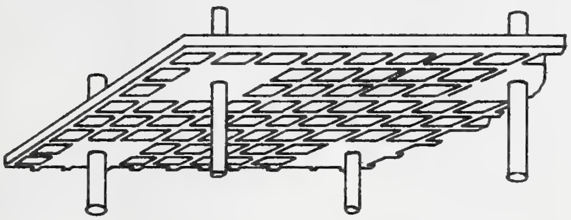
ONE WAY JOIST-SLAB FLOOR CONSTRUCTION



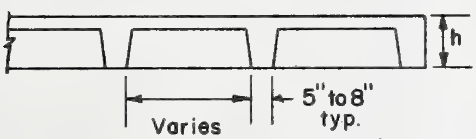
ONE WAY JOIST-SLAB FLOOR SYSTEM

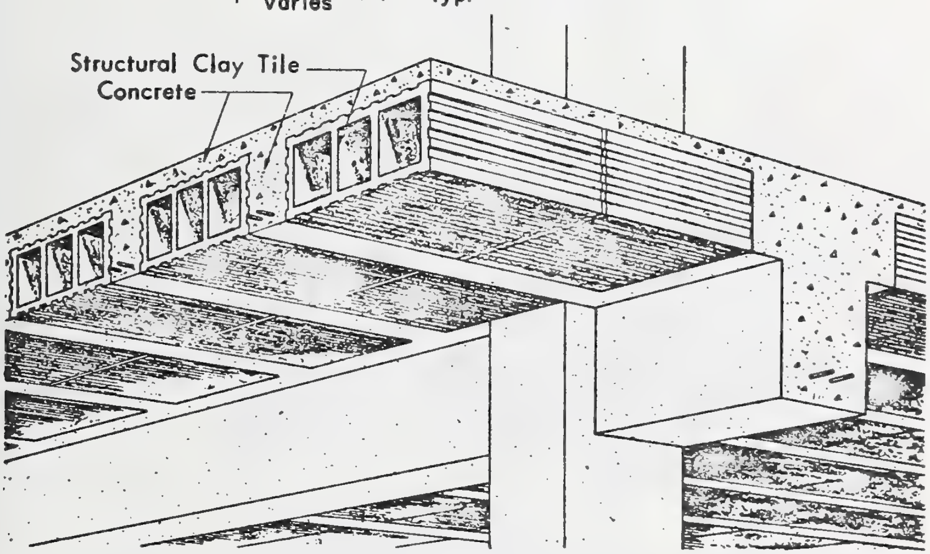


WAFFLE-SLAB FLOOR CONSTRUCTION



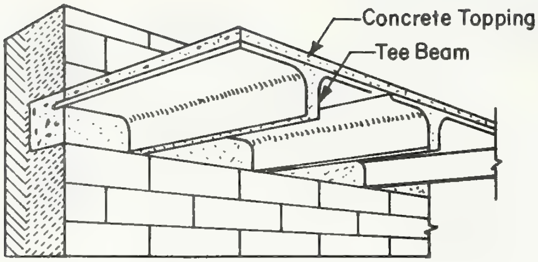
WAFFLE-SLAB FLOOR SYSTEM





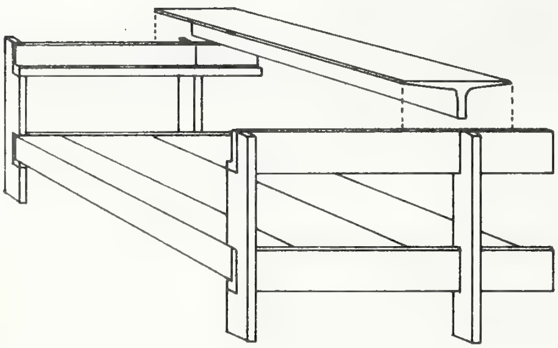
Combination Clay Tile and Concrete Slab

Figure A.17

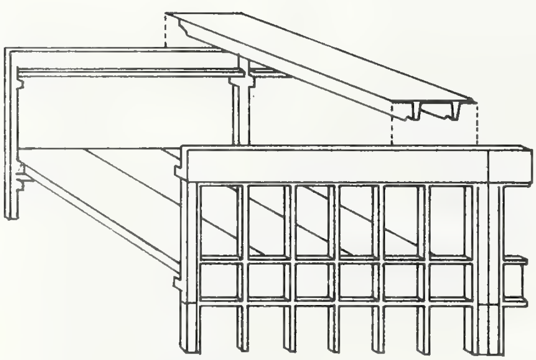


CONCRETE TEE BEAMS

SINGLE-T FLOOR CONSTRUCTION WITH LOAD-BEARING WALL



SINGLE-T FLOOR CONSTRUCTION WITH CONCRETE FRAME BUILDING

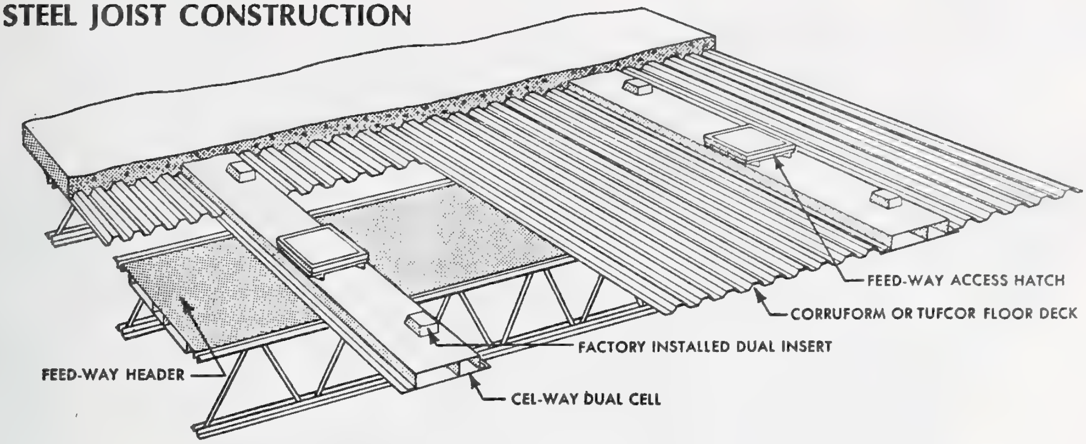


DOUBLE-TEE FLOOR SYSTEM

DOUBLE-T FLOOR CONSTRUCTION

Figure A.18

STEEL JOIST CONSTRUCTION



Open Web Joist Construction

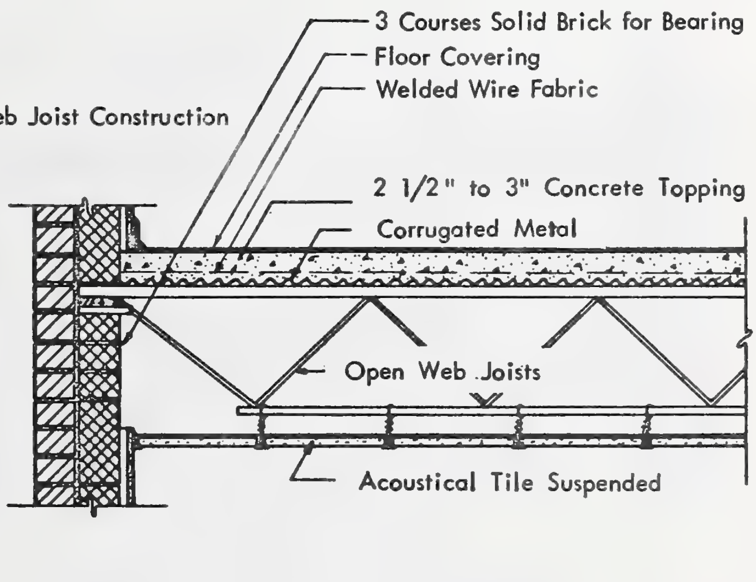


Figure A.19

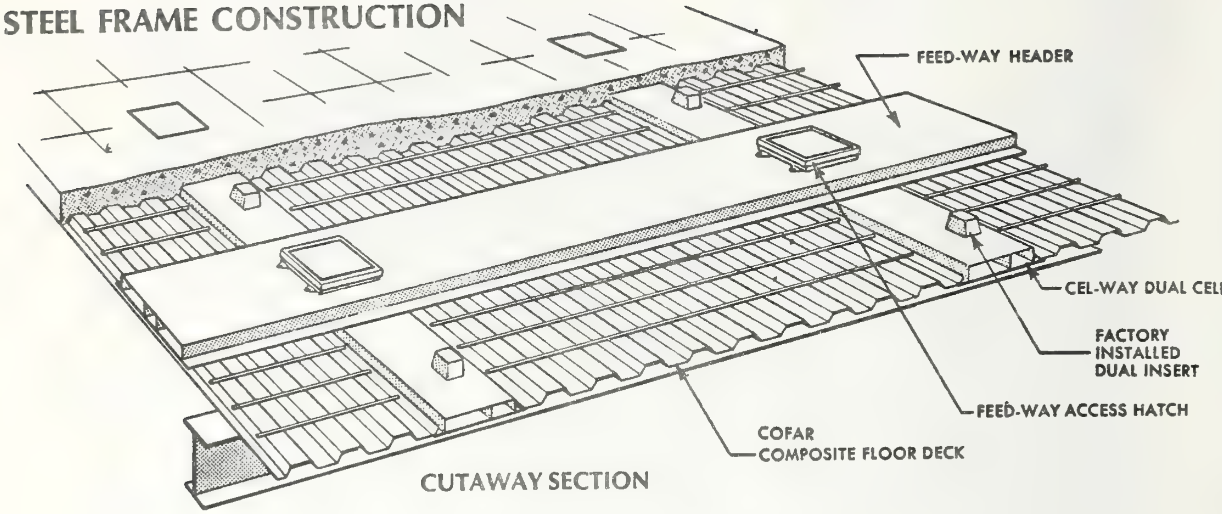
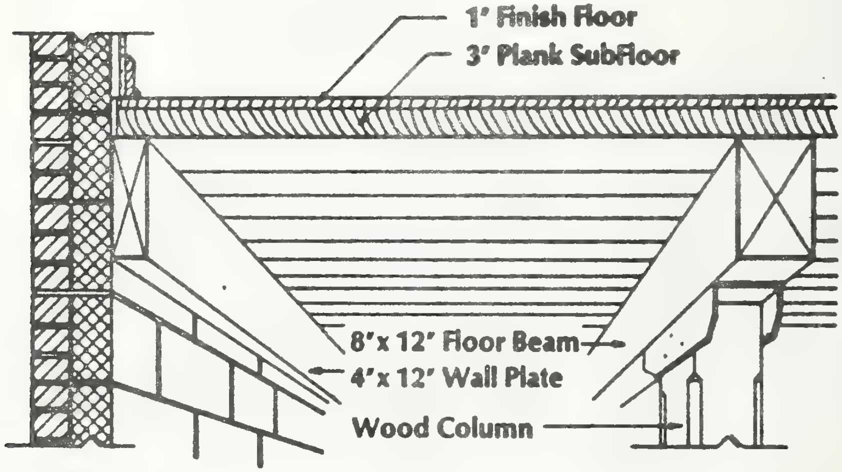
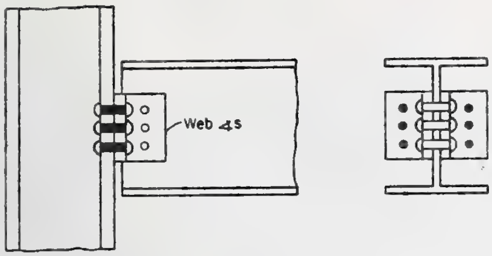


Figure A.20

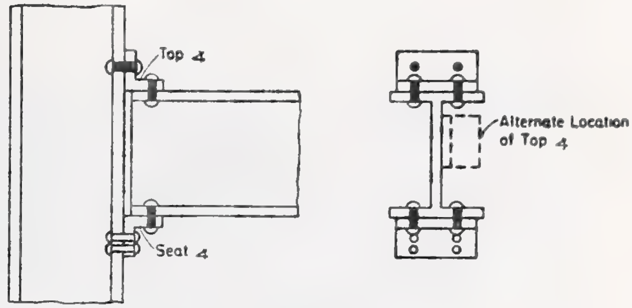


Heavy-Timber or Mill Construction

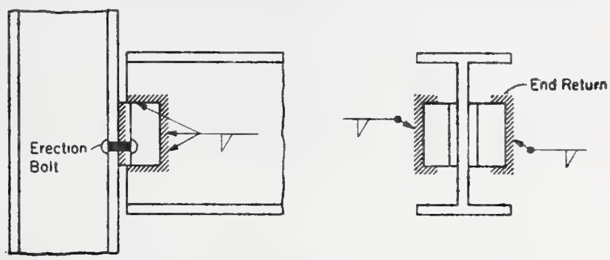
Figure A.21



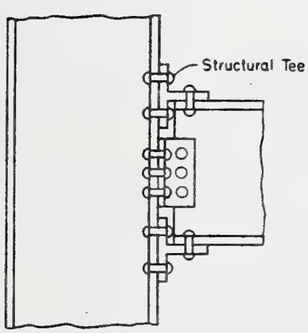
(a) Framed simple connection (bolted or riveted)



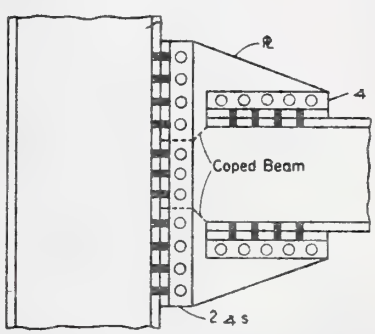
(b) Seated simple connection (bolted or riveted)



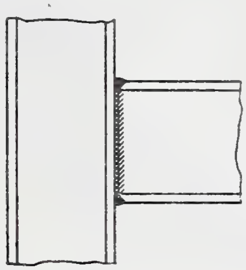
(c) Framed simple connection (welded)



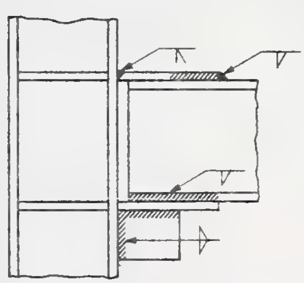
(a) Structural tee connection



(b) Bracket connection



(c) Welded moment-resisting connection



(d) Welded moment-resisting connection

Figure A.22

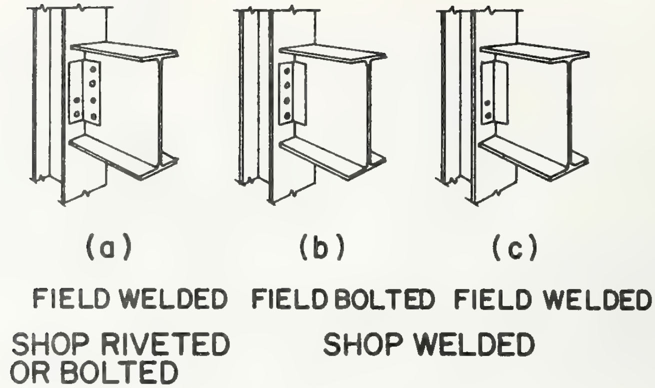


Figure A.23

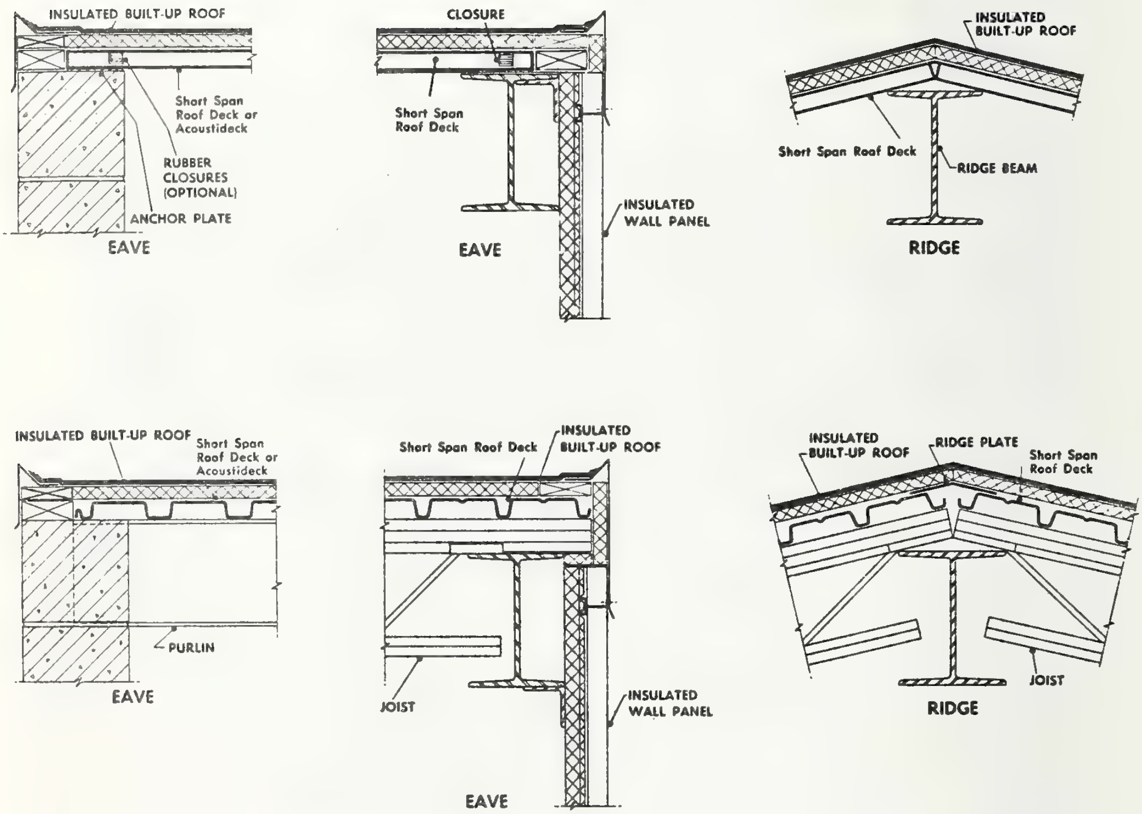


Figure A.24

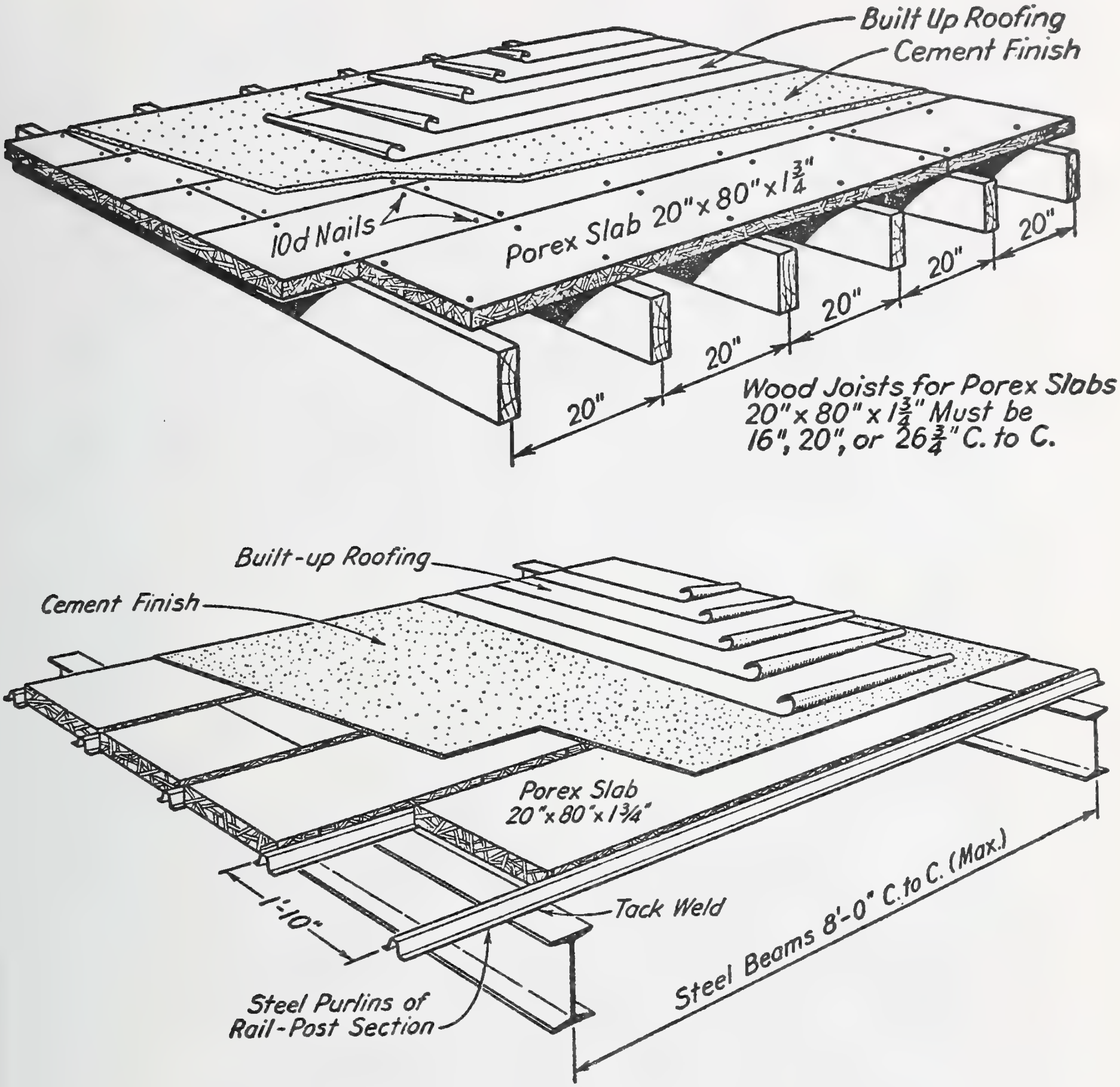
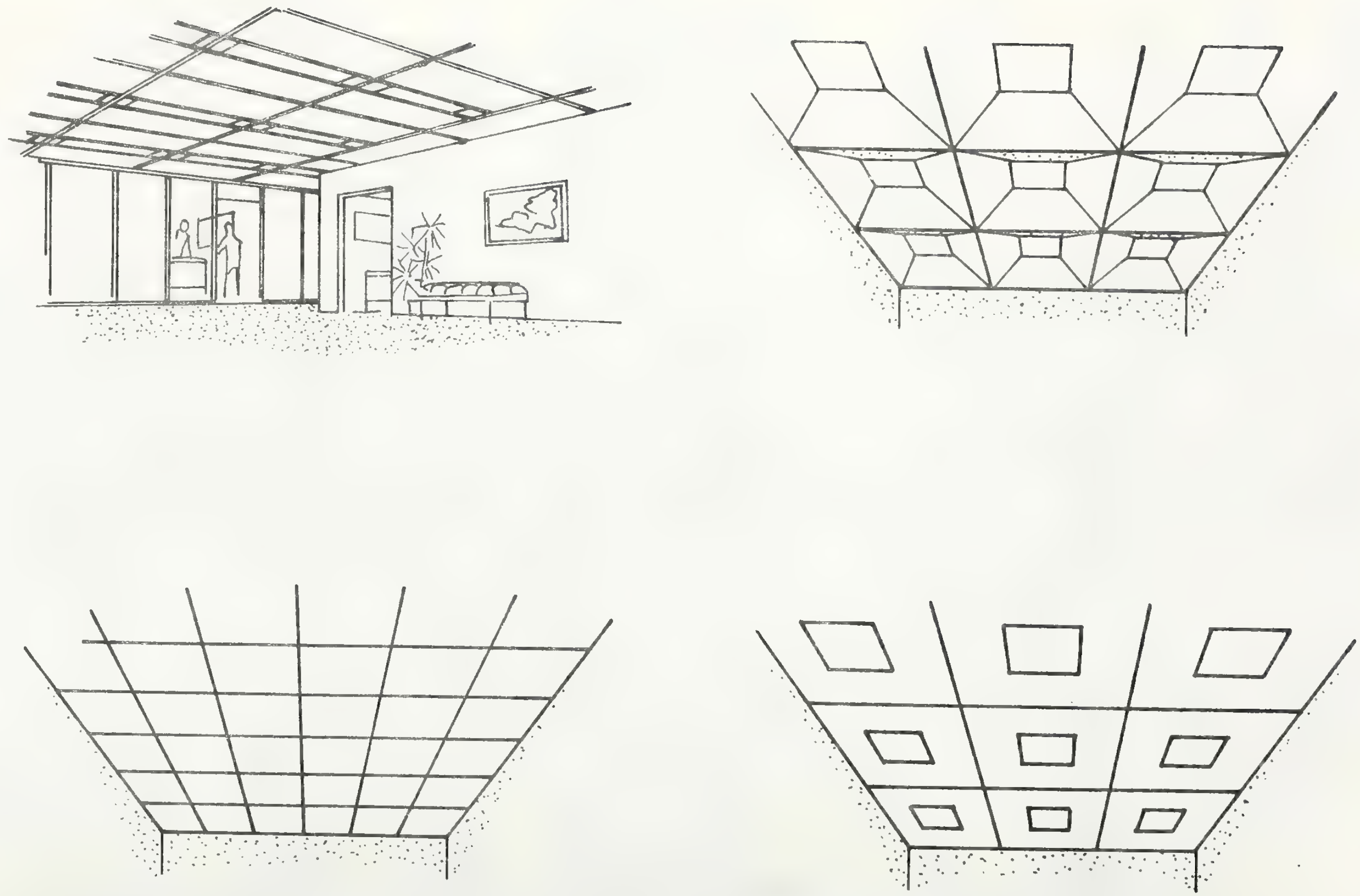

Built Up Roofing
Cement Finish
10d Nails
Porex Slab 20"x 80"x 1¾"
20"
20"
20"
20"
20"
Wood Joists for Porex Slabs 20"x 80"x 1¾" Must be 16", 20", or 26¾" C. to C.
Built-up Roofing
Cement Finish
Porex Slab 20"x 80"x 1¾"
1'-10"
Tack Weld
Steel Beams 8'-0" C. to C. (Max.)
Steel Purlins of Rail-Post Section

Figure A.25



Typical Appearance of Acoustical Tile Ceilings

Figure A.26

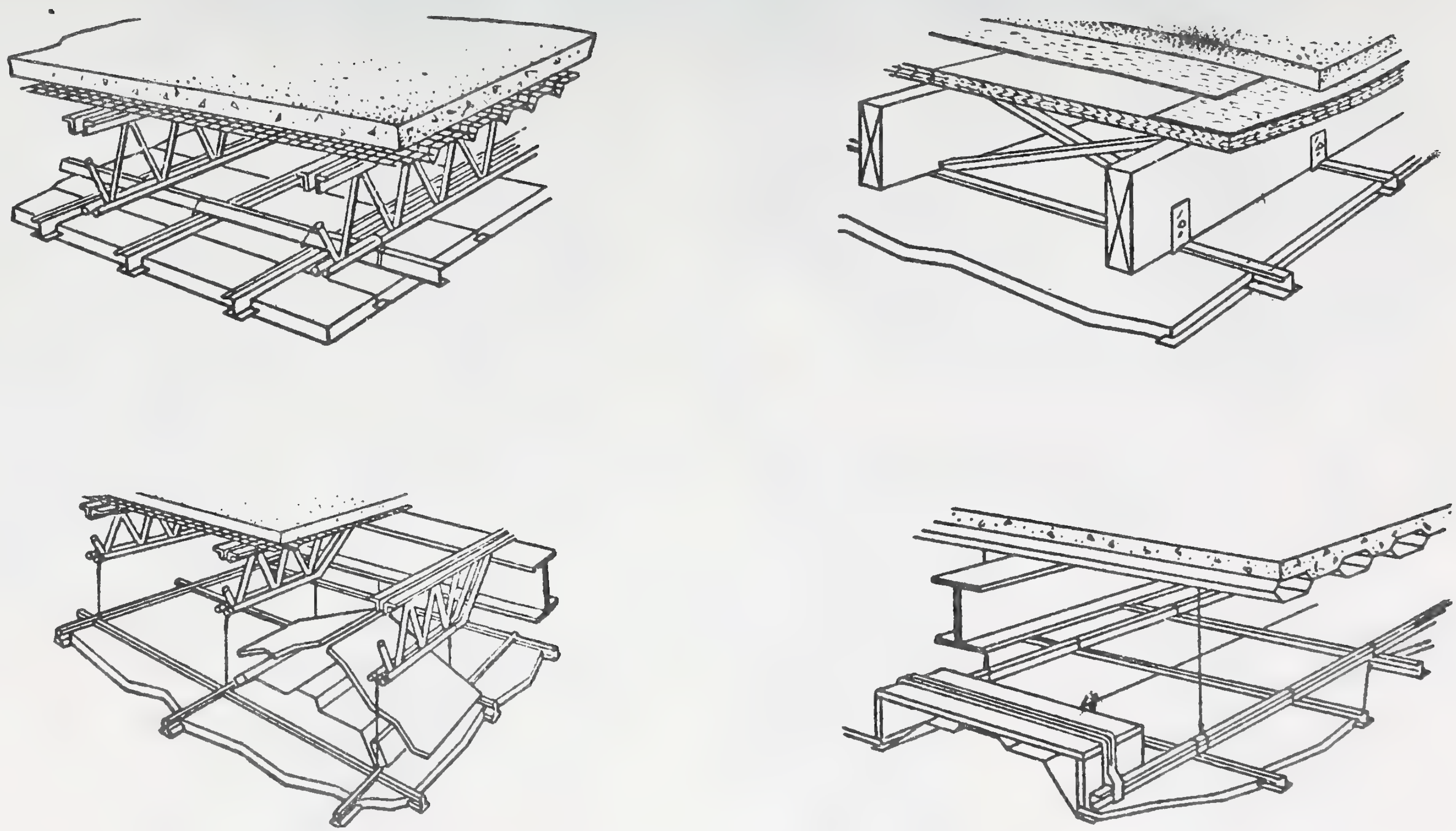


ILLUSTRATION OF DIRECTLY ATTACHED AND SUSPENDED ACOUSTICAL TILE CEILINGS

Figure A.27

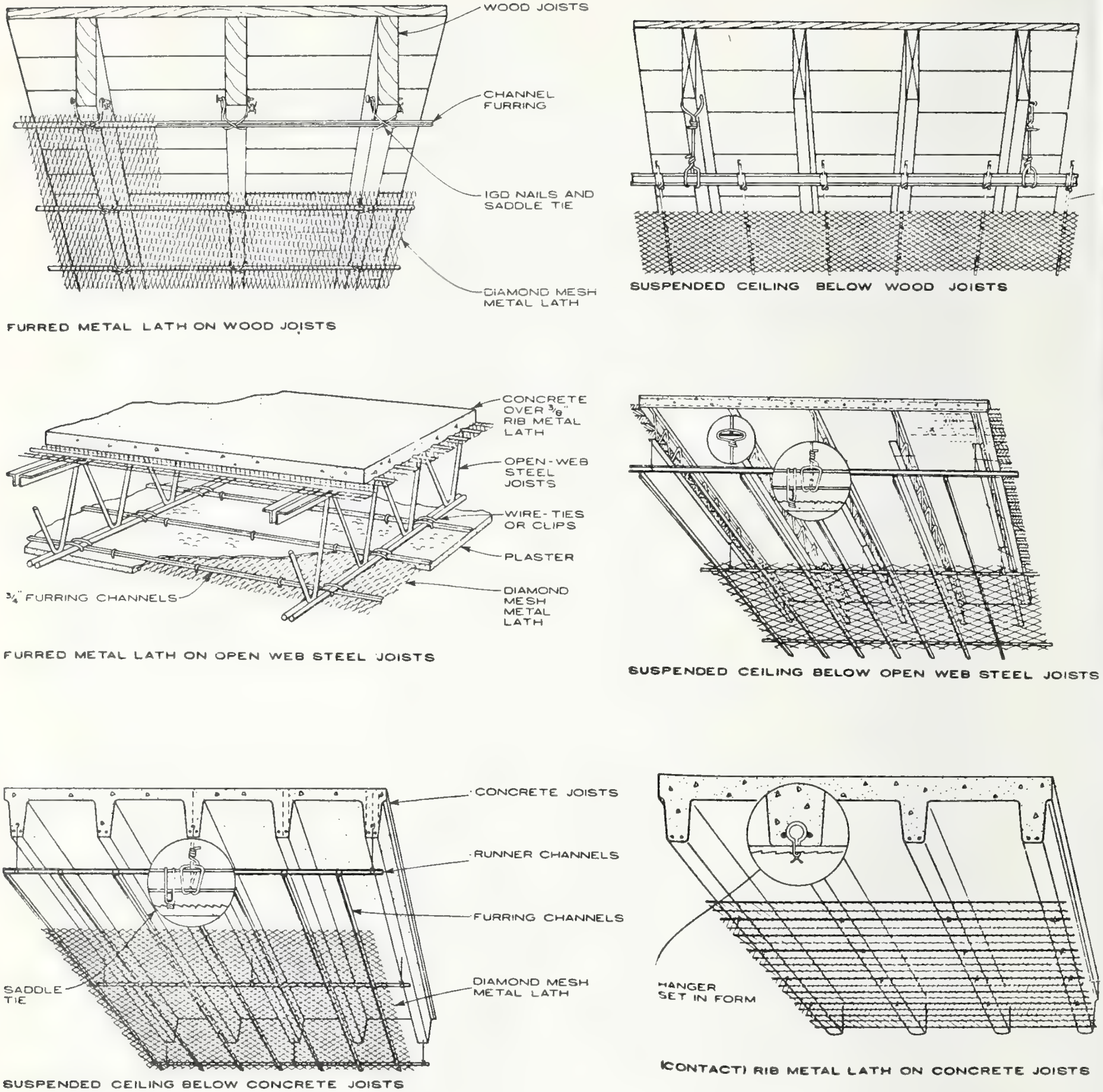
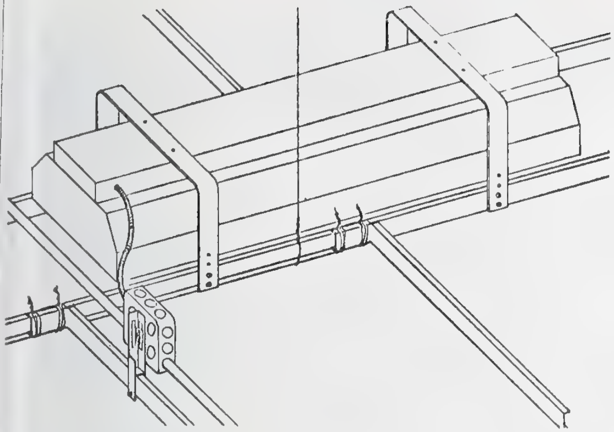


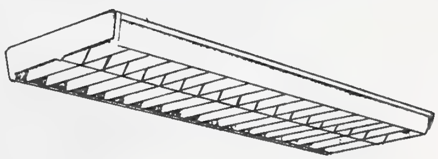
ILLUSTRATION OF DIRECTLY ATTACHED AND SUSPENDED PLASTER CEILINGS

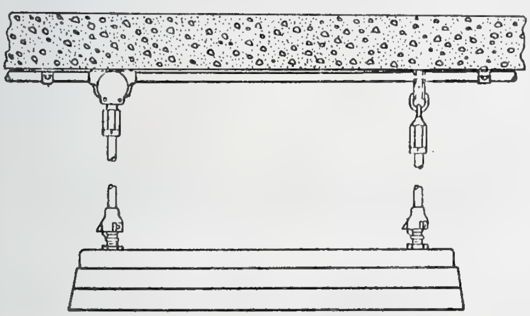
Figure A.28



RECESSED FIXTURE

SURFACE MOUNTED FIXTURE





PENDANT FIXTURE

Figure A.29

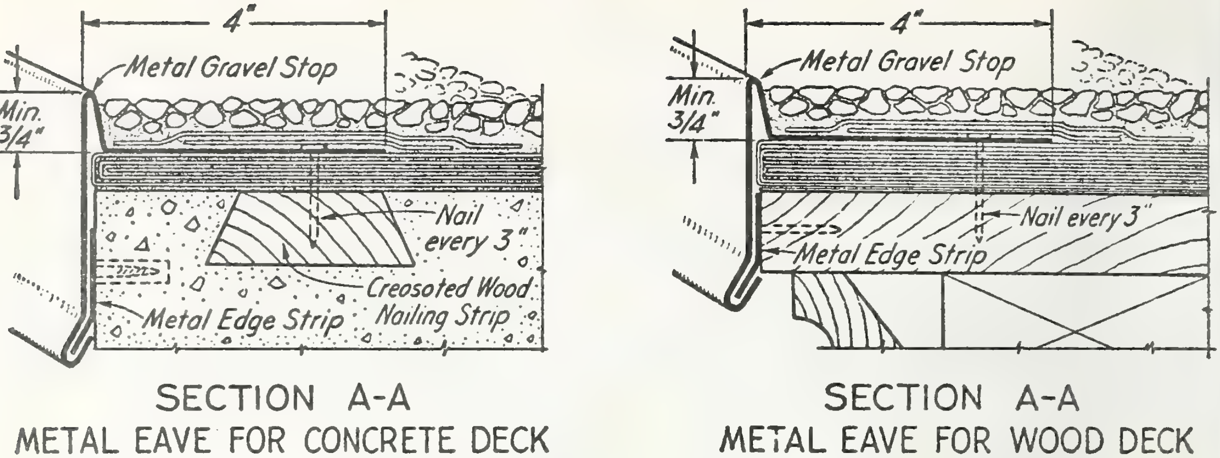


Figure A.30

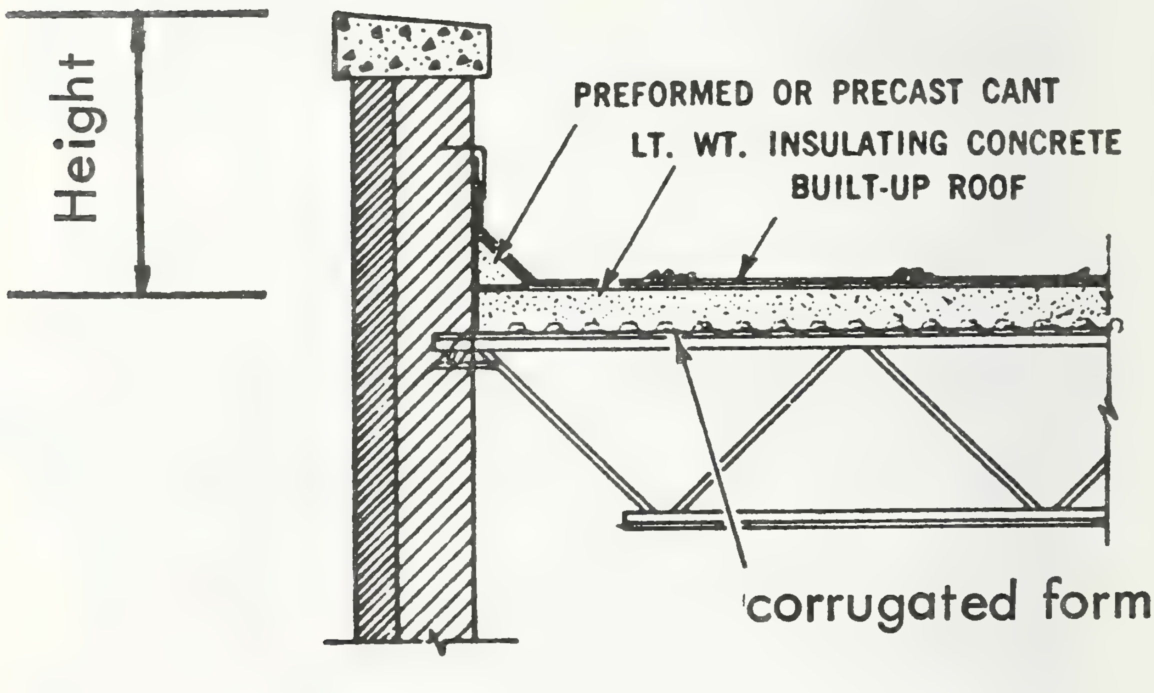
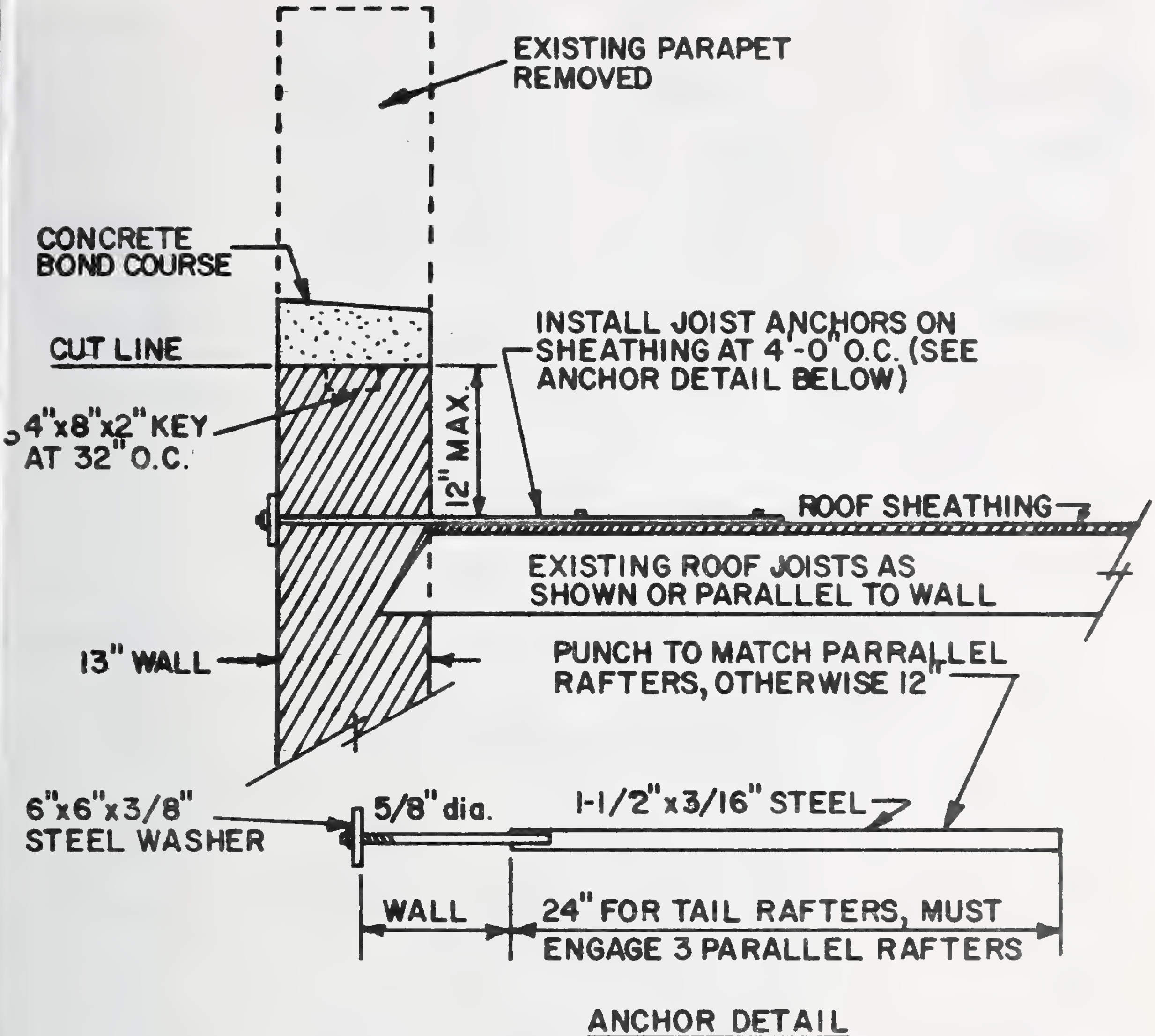


Figure A.31



STANDARD PARAPET CORRECTION DETAIL

Figure A.32

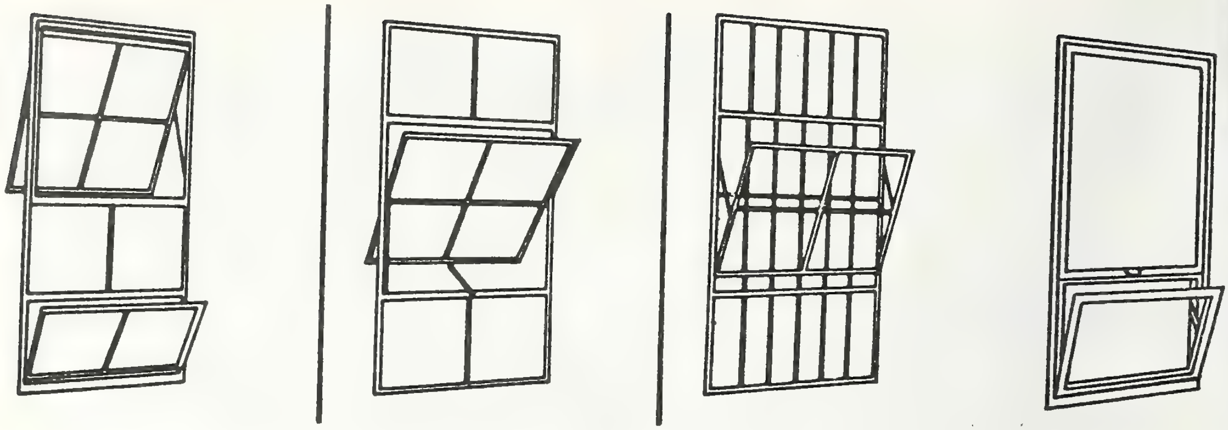


Figure A.33

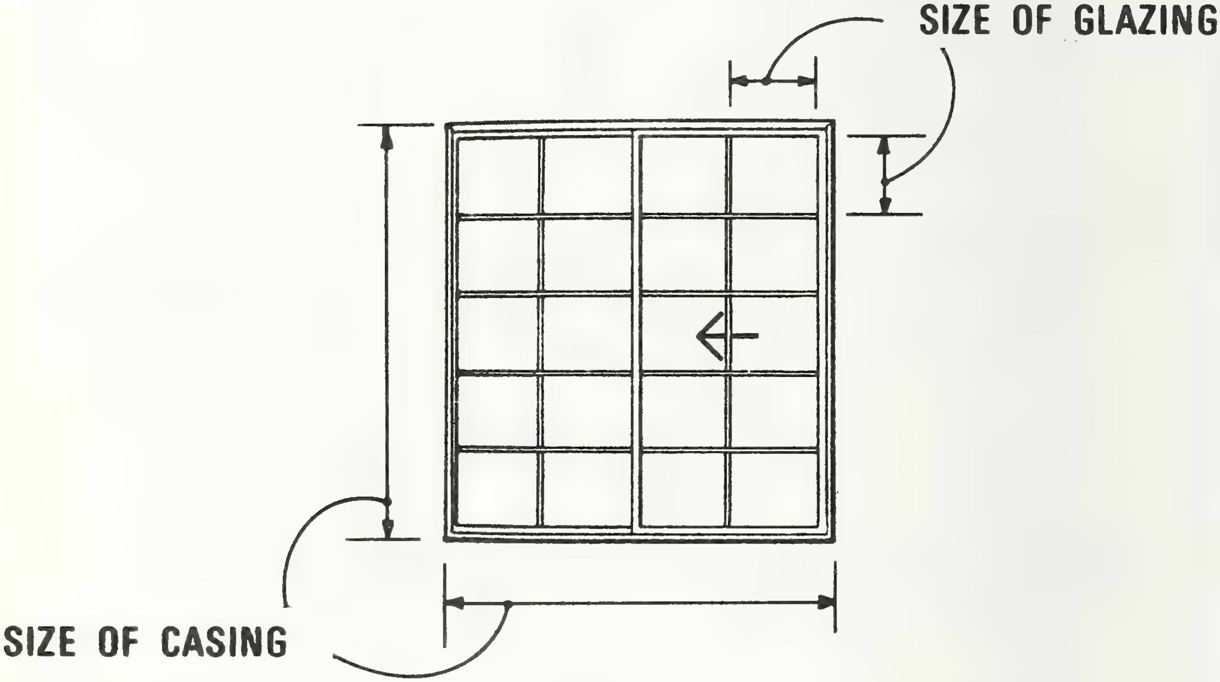


Figure A.34

APPENDIX B

FIELD EVALUATION METHOD

B.1 PROCEDURE IN EVALUATING BUILDING FOR EARTHQUAKE HAZARD - FIELD EVALUATION METHOD

The Data Collection Form should be checked with the plans if they are available. The seismicity of the site shall be determined by the user. From the information given on the Data Collection Forms or the plans, the "Type" of building can be determined and the "General Rating" selected from the data given on Form FMA-1. The "Symmetry" and "Quantity" of the Vertical Resisting Elements is estimated. A discussion of these items is given in section 3.2. This procedure is followed for both "Transverse" and "Longitudinal" loading. The method of rating these is given on Form FMA-1 and a "Symmetry Quantity Rating (SQR)" is determined. The DC Form is checked to see if any of these elements are damaged and an estimate of the degree of damage is made. It may be desirable to revisit the site to check on this damage or refer to pictures. This is necessary to give the "Present Condition: rating. Finally, the "Sub-Rating (SR1)" is obtained as shown on Form FM-1.

The Horizontal Resisting Elements are next investigated for "Rigidity", "Anchorage and Connections" and "Chords" are rated for their presence or non-presence. Then a "Sub-Rating" is obtained as shown on Form FMA-2.

Finally, "Sub-Ratings (SR1) and (SR2) as well as the "General Rating" are used to establish the "Basic Structural Rating" and the "Capacity Rating." The method of doing this is described on Form FME. The "Capacity Ratio" then gives a measure of the ability of the building to resist an earthquake at the site.

Exit corridors and stair enclosure walls are rated for general safety on Form FMB-1. The various types of walls and their anchorages are given relative ratings.

Other Life Hazards such as Partitions Other Than on Corridors or Stair Enclosures, Glass Breakage, Ceilings, Light Fixtures, and Exterior Appendages and Wall Cladding are rated as shown on Form FMB-2. If the building has an earthquake gas connection, this is also noted on Form FMB-2.

B.2 PROCEDURE IN EVALUATING BUILDING FOR WIND HAZARD - FIELD EVALUATION METHOD

The Data Collection Form should be checked with the plans if they are available. The type of exposure and the height of the building is taken from the DC Forms and put on Form FMC-1. The basic wind speed for the site must be determined by the user. With these data the tables in ANSI A58.1-72 [3.2] are used to determine the effective velocity pressure and the design unit pressures for positive and negative pressures determined for use in rating the building as a whole.

Sub-Ratings SR1 and SR2 for vertical and horizontal resisting elements are obtained as described in section B.1 and Forms FMA-1 and FMA-2. The "General Rating" is selected from the data given on Form FMA-1. The "Basic Structural Rating" is then determined by the formula given on Form FME.

The "Uplift Anchorage Factors" rating is taken from the information given on Form FMC-1 and the "Corrected Structural Rating" is selected. With the "Corrected Structural Rating," the "Effective Unit Velocity Pressure Capacity" is obtained from the bottom of the form.

The "Capacity Ratio" which is the ratio of the anticipated wind pressure to the pressure which the building can withstand is then computed and entered on Form FME.

The evaluation of Other Life Hazards such as Glass Breakage, Window Frame Anchorage, Roof Panel Anchorage, Wall Panel Anchorage, and Anchorage of Exterior Appendages is given from information obtained from the DC Form or the plans, if they are available. Without calculations, these can only be approximate ratings. These ratings are noted on Form FMC-2.

The presence of potential wind blown missiles is noted, along with "Type," "Location" and "Distance" from the structure in the table at the bottom of Form FMC-2.

B.3 PROCEDURE IN EVALUATING BUILDING FOR TORNADO HAZARD - FIELD EVALUATION METHOD

The procedure for evaluating a building for tornado hazard is similar to that described for wind except that a so-called "Moderate Tornado" is used as a standard with arbitrarily assumed positive and negative pressures.

The "Basic Structural Rating" is obtained from Form FME as for wind. "Uplift Anchorage Factors" and a "Corrected Structural Rating" are determined as for wind. From this "Effective Unit Velocity Pressure" is obtained as for wind. The ratings are then assigned as given on Form FMD. One other item is used in the rating. If this building is a "Vault-Type" structure as described in section 3.2, it is given a "Good" rating.

The hazards from wind blown debris, both from the building being analyzed and from outside the building, are described as to "Type" and "Location" from information given on the DC Form. The ratings for these hazards is obtained from Form FMD.

Information relative to the suitability and capacity of a basement to serve as a storm shelter is placed in the lower table on Form FMD.

B.4 INSTRUCTIONS FOR USE OF FIELD EVALUATION METHOD RATING FORMS

FORM FMA - 1 - STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

Form FMA - 1 evaluates the vertical resisting elements. In filling out Form FMA-1, in the column headed "Type," the letter designating the type of construction should be placed in the first column. The number indicating the "General Rating" (GR) should also be placed in the form with the earthquake general rating in the column indicated by the symbol "E" and the wind general rating placed in the column designated with the symbol "W." This applies to both transverse and longitudinal loadings.

The next two columns are for "Symmetry" (S) and "Quantity" (Q). Section 3.2 discusses the basis for evaluation of these categories.

The next column is for the "Symmetry-Quantity Rating" (SQR) which is $\frac{S + Q}{2}$.

Thus if S = 3 and Q = 2, this rating will be $\frac{3 + 2}{2} = 2.5$.

The appropriate rating for "Present Condition" is selected based on the categories listed on the form.

"Sub-Rating" (SR1) is the weighted average in which the "Present Condition" (PC) is given 2 times the value of the "Symmetry-Quantity Rating" (SQR). Thus $SR1 = \frac{SQR + 2PC}{3}$.

FORM FMA - 2 - STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

Form FMA-2 evaluates the horizontal resisting elements. Both roof and floors are evaluated. Section 3.2 discusses floor and roof systems and this form provides for the development of a rating.

In the "Type" column, insert either "A" for Diaphragm or "B" for Steel Horizontal Bracing. Under "Rigidity" (R) place the appropriate rating number from the categories listed.

The ratings for "Anchorage and Connections" and "Chords" are selected from the data given below the table.

"Sub-Rating (SR2)" for both floors and roof is the highest number under "Rigidity," "Anchorage" or "Chords."

FORM FMB-1 - EXIT CORRIDOR AND STAIR ENCLOSURE WALLS - EARTHQUAKE:

The necessary information for filling out this form will be obtained in the field and be available from the Data Collection Form (DC) or may be obtained from the plans. If the information for "Reinforcement" or "Anchorage" is not available, the column entitled "Not Known" should be checked.

"Wall Rating" is determined as follows:

- Where the enclosure walls are of reinforced, cast-in-place concrete or reinforced masonry, and the floors or roof are cast-in-place concrete, it is very probable that such walls will be well-anchored and be a good risk. In such cases an "A" rating will be given.
- Where walls are of unreinforced masonry, unless special anchorage devices are found, a "C" rating will be given.
- Metal stud and plaster walls, or metal studs and drywall walls, if anchored, will be given an "A" rating. Tilt-up concrete walls or pre-cast concrete walls are usually reinforced. They are usually provided with some anchorage but this may or may not be adequate, and the anchorage is usually not visible. If plans show a substantial type of anchorage, an "A" rating should be given. If the anchorage is unknown, an "X" rating should be given. If it is obvious that there is no positive anchorage to the floor or roof above, a "C" rating should be given.
- Wood stud and plaster walls are usually nailed to wood floors and since they are light should be given an "A" rating if attached directly to floors or roof. If free-standing and only attached at the bottom by nails or drive-in fasteners, a "C" rating should be given.
- Hollow tile walls are rarely reinforced and are usually only anchored by a mortar joint. Unless there is positive evidence of special anchorage or of wall reinforcement, the rating will be "C."

The letter ratings are used here rather than numerical ratings because of the generalized nature of the data available from the DC Forms and because mathematical analysis of these exit corridor and stair enclosure walls is not contemplated by the Field Evaluation Method. This is true also for the ratings on Form FMB-2.

FORM FMB-2 - OTHER LIFE HAZARDS - EARTHQUAKE:

Glass Breakage. This hazard usually will be evaluated only on street fronts or adjacent to public ways unless other special locations are deemed to have a high hazard to life. Where the upper levels of a building are set back adjacent to a street front, and if the set back wall has windows whose height above the low roof of the setback is greater than the roof width, such window glass will be considered on a street front. If the glazing requirements of table 3.1 are complied with, the rating given will be "A." If there is very little or no compliance, a "C" rating will be given. Degree of compliance in between these two will be given a rating of "B." If it is not possible to determine the degree of compliance, then an "X" rating should be given. See figure 3.5 where some typical details are given showing how provisions for drift may be made. Earthquake forces normal to the plane of glass are relatively minor because such forces are proportioned to the weight of the glass.

Exterior Appendages and Wall Cladding. The anchorage of exterior appendages and wall cladding elements will probably not be visible unless such an element has fallen off and left the anchorage exposed. If this is noted on the elevations on the DC Form, the remaining anchorage should be checked for corrosion if possible and if corrosion is found, anchorage of other similar elements is suspect. In most cases, however, the anchorage must be determined from plans and specifications. The adequacy of anchorage can be accurately determined only through calculations. This is beyond the scope of the Field Evaluation Method. However, with the exercise of some judgment and "feel," a very approximate hazard rating can be given. The probable types of anchorage for exterior appendages and wall cladding is shown on table 3.2 with appropriate rating recommendations.

Ceilings. For the Field Evaluation Method, the ceiling hazard will be determined by visual observation or perusal of plans and specifications. The items to be determined are whether there is wire X-bracing in the ceiling space, whether the suspended ceiling structural elements (tee-bars or channels) are well-connected to exterior walls or structural members, and whether the structural elements are connected together so as to form an adequate strut between bracing. The presence of heavy light fixtures supported laterally by this ceiling will be noted and, if possible, a determination made as to whether such heavy light fixtures are independently supported. An approximate rating system is suggested as follows:

- Suspended ceilings with good anchorage or confinement of structural ceiling elements to structure of building and good continuity of elements .... A
- Suspended ceilings with frequent wire cross-bracing, both directions .... A
- Incomplete bracing but good continuity .... B
- Suspended ceilings without either X-bracing or adequate connections to walls C
- Suspended ceilings with heavy light fixtures supported vertically or laterally by the ceiling C

Light Fixtures. If access to attic space is available it may be possible to view the support systems for heavy light fixtures. If swivel joints and restraining devices are found, it is probable that the fixture will respond satisfactorily in most earthquake shocks. If not, the fixture supports may break loose and drop. Heavy fixtures supported by the ceiling system itself are covered under the ceiling rating. For the Field Evaluation Method, it is suggested that if no swivel joints or restraining devices are found, unless independently braced, a rating of "C" be given. If they are found, the "A" rating is suggested. No "B" rating is used for this item. If obvious looseness of vertical support connections are noticed, give a "C" rating. The rating should be "A" if no heavy light fixtures are found. An "X" rating should be given if the fixture connection cannot be seen.

Earthquake Gas Connection. Note the presence or non-presence of an earthquake gas connection. If this cannot be determined, check "Not Known."

FORM FMC - 1 STRUCTURAL SYSTEM - WIND RATING

In filling out the rating form, FMC-1, the "Basic Wind Speed" will be that assigned to the area based on information in ANSI A58.1-72. "Exposure" ("A," "B," or "C") is determined from the information on Form DC-7.

When the "Exposure" and "Height" have been determined, go to table 5 of ANSI (there is a table 5 for each of the three exposures) and select the "Effective Velocity Pressure." Multiply by 1.3 or 1.4 (for consideration of the effect of both windward and leeward pressure on the building as a whole) to arrive at the "Design Unit Pressure." "Basic Structural Rating" is taken from Form FME.

The "Uplift Anchorage Factors" are determined from the data on the DC Form and the information given on FMC-1. The "Corrected Structural Rating" is simply the highest numerical rating of either the "Foundation Anchorage," the "Roof Anchorage" or the "Basic Structural Rating."

Go to the bottom of the form and select the "Effective Unit Velocity Pressure Capacity - P_c." Now compute the "Capacity Ratio" with the formula P/P_c. Obviously if P/P_c is greater than 1, the risk is greater; if less than 1, the risk is less. The maximum P_c given on this form is 45. Some buildings, because of height or exposure, may be subjected to much higher pressures "P." Important buildings with a "Capacity Ratio" of 1 or greater should be reviewed by Analytical Methods when P_c is over 45.

FORM FMC-2 - OTHER LIFE HAZARDS - WIND RATING

The important items involved are the strength and size of glass panels, their frame and glazing attachments, and the anchorage of roof panels and of light exterior wall panels and appendages. The rating of some of these may not be determinable by visual inspection. If plans and specifications are available they may show details of glazing and other pertinent anchorages. Proximity to potential wind-born missiles may or may not be obvious, but if a structure were to be located adjacent to an unenclosed lumber yard or similar source of airborne debris, it should be noted. Space is provided on the DC Form for this. With such limitations the Life Hazard rating must be very approximate. Even where anchorages or attachments are present, it would require detailed calculations to fully check them for adequacy.

Glass breakage from forces normal to the plane of glass is more of a hazard in wind than in earthquake. Here the strength of the glass and its thickness and span are the important factors. This is difficult to determine in the field. However, where size of glass panes and thickness of glass can be determined, these items can be compared with the requirements shown on table 3.1. If these comply, the rating should be "A;" if there is medium or partial compliance, the rating should be "B;" if there is little or no compliance the rating is "C;" if unknown, the rating is "X."

Window frame anchorage is important on tall, flexible buildings. Buildings with moment-resistant frames and light exterior curtain walls over 3 stories high and buildings with exterior concrete or masonry walls over 8 stories high fall into this category. In these instances the wind forces parallel to the plane of glass are important and details providing for drift similar to those shown on figure 3.5 should be provided. If drift details have been provided, the rating should be "A;" if not, the rating should be "C." There is no provision for a "B" rating on this item.

The anchorage of roof panels, light wall panels, and exterior appendages is also important. Where the anchorage can be determined, the best judgment must be exercised since detailed computations are not available in the Field Evaluation Method. If what appears to be good anchorage is confirmed, the rating should be "A;" if the anchorage is known to be poor or is obviously missing, the rating should be "C;" if the anchorage is confirmed but appears to be somewhat inadequate or questionable, the rating will be "B;" if the anchorage is unknown, the rating is "X."

In filling out the rating form, the best judgment should be exercized. Place rating terms ("A," "B," "C," and "X") in the appropriate squares.

Under "Potential Missiles from Outside of Structure," note the type of material, the "Quantity" (large or small), and the distance.

FORM FMD TORNADO RATING

The purpose of the FMD Form is to rate the facility as to its exposure and resistance to tornado hazards. The probability of tornado occurrence to the particular area will be provided. The tornado funnels usually move laterally fairly rapidly so that the time of full exposure of any one structure is of comparatively short duration.

The "Effective Unit Velocity Pressure Capacity P_C" may be taken directly from Form FMC-1 if the building has been rated for wind; if not, evaluate as for Wind Rating.

The DC Form have information which will determine whether or not the building will qualify as a vault-type structure. The definition of such a structure is given in section 3.2. If it does so qualify, check the "Yes" box; if not, the "No" box. The "Building-As-A-Whole" is then rated from information in previous columns of the table and the ratings given below the table. For example if P_C = 40 or over, the rating "Fair" is given.

In the table entitled "Hazard from Wind-Blown Debris," the "Location" and "Type" columns are filled out from material given in the DC Forms. The location and type of potential debris inside the building is placed in the columns opposite "Wall Cladding, Appendages, or Glass;" location and type of potential debris outside the building is placed opposite "Other Potential Debris Not Part of the Building." The hazard is then rated. If there is no potential wind blown debris present, the rating "Good" is given; if there is a small amount of potential debris, the rating will be "Fair;" if there is a large quantity, the rating will be "Poor."

The table "Basement Storm Shelter Availability" is primarily informative. Note the presence or non-presence of such a basement. If present, the effective area of the basement should be obtained from the DC Forms and "Capacity" computed on the net effective area based on 15 sq. ft. per person. The building may be either "Suitable" or "Unsuitable" from criteria given in section 3.2.

FORM FME CAPACITY RATIOS - EARTHQUAKE AND WIND RATING

Form FME gives the "Capacity Ratio" to be used in evaluating the ability of the structure to respond to anticipated winds or earthquakes. The "General Rating," taken from Form FMA-1, is placed in the first column. "Sub-Rating SR1" is also taken from Form FMA-1 and is the larger of either the "Transverse Loading" or the "Longitudinal Loading." "Sub-Rating SR2" is taken from Form FMA-2. If the "Sub-Rating (SR2) for "Roof" and "Floors" are not the same, use the larger of the two ratings. Compute the "Basic Structural Rating" using the formula shown below the table. This rating system is intended to provide relative resistive capacities of the buildings evaluated. Without analytical review such ratings can only be approximated.

Capacity Ratio. For Earthquake, the relationship of the "Basic Structural Rating" to ground intensity as given by Modified Mercalli Scale as described by the Seismic Capacity Ratio = $\frac{\text{Basic Structural Rating}}{\text{Intensity Level at Site}}$ in which an approximate "Intensity Level Factor" is assigned for the pertinent Modified Mercalli Scale. The Modified Mercalli Scale is given on table 3.3. The "Capacity Ratio" is a measure of the capacity of the building to resist an earthquake of the intensity level expected at the individual site. "Capacity Ratio" for Wind is obtained from Form FMC-1.

The "Capacity Ratio Rating" included on Form FME gives an approximate meaning to various "Capacity Ratio" values.

B.5 EVALUATION FORMS FMA TO FME

This section presents the evaluation forms for the Field Evaluation Method.

FACILITY NO. ________________ EXPECTED SITE MODIFIED MERCALLI INTENSITY __________

FIELD EVALUATION METHOD

STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

VERTICAL RESISTING ELEMENTS							
Type	General Rating (GR) E	General Rating (GR) W	Symmetry (S)	Quantity (Q)	Symmetry Quantity Rating (SQR) [1]	Present Condition (PC)	Sub-Rating (SR1) [2]
TRANSVERSE LOADING							
LONGITUDINAL LOADING							

FOOTNOTES:

1. Symmetry-Quantity Rating (SQR) = $\frac{S + Q}{2}$.
2. Sub-rating SR-1 = $\frac{SQR + 2PC}{3}$.

	TYPE	GENERAL RATING (GR) Earthquake	GENERAL RATING (GR) Wind
A	Steel Moment Resistant Frames	1	1
B	Steel Frames - Moment Resistance Capability Unknown	2	2
C	Concrete Moment Resistant Frames	1	1
D	Concrete Frames - Moment Resistance Capability Unknown	2	2
E	Masonry Shear Walls - Unreinforced	4	2 or 3
F	Masonry or Concrete Shear Walls - Reinforced	1	1
G	Combination - Unreinforced Shear Walls and Moment Resistant Frames	2	2
H	Combination - Reinforced Shear Walls and Moment Resistant Frames	1	1
J	Braced Frames	1	1
K	Wood Frame Buildings, Walls Sheathed or Plastered	1 or 2	2 or 3
L	Wood Frame Buildings, Walls Without Wood Sheathing or Plaster	4	4

SYMMETRY (of Resisting Elements)

1	Symmetrical
2	Fairly Symmetrical
2 or 3	Symmetry Poor
3 or 4	Very Unsymmetrical

NOTE: Add 1 (not to exceed 4) to each rating if a high degree of vertical non-uniformity in stiffness occurs.

QUANTITY (of Resisting Elements)

1	Many Resisting Elements
2	Medium Amount of Resisting Elements
3	Few Resisting Elements
4	Very Few Resisting Elements

NOTE: If exterior shear walls are at least 75% of building length, this rating will be 1.

PRESENT CONDITION (of Resisting Elements)

1	No Cracks, No Damage
2	Few Minor Cracks
3	Many Minor Cracks or Damage
4	Major Cracks or Damage.

NOTE: If masonry walls, note quality of mortar - good or poor. If lime mortar is poor, use next higher rating.

FACILITY NO. ____________ FORM FMA-2

FIELD EVALUATION METHOD

STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

HORIZONTAL RESISTING ELEMENTS						
Type		Rigidity (R)	Anchorage & Connections (A)	Chords (C)		Sub-Rating (SR2)
				Longitudinal	Transverse	
Roof						
Floors						

Note: Sub-rating SR2 = Largest of R, A or C.

Type
A Diaphragm
B Steel Horizontal Bracing

Rigidity - Ratings
1. Rigid
1.5 Semi-rigid
2.0 Semi-flexible
2.5 Flexible

Anchorage and Connections - Ratings
1 Anchorage confirmed - capacity not computed, but probably adequate.
2 Anchorage confirmed - capacity not computed, but probably inadequate.
3 Anchorage unknown.
4 Anchorage absent.

Chords - Ratings
1 Chords confirmed, but capacity not computed.
2 Chords unknown, but probably present.
3 Chords unknown, but probably not present.
4 Chords absent.

FACILITY NO. ________________

FIELD EVALUATION METHOD

EXIT CORRIDOR AND STAIR ENCLOSURE WALLS - EARTHQUAKE RATING

TYPE OF WALL	REINFORCEMENT			ANCHORAGE					WALL RATING
	Present	Not Present	Not Known	Mortar Only	Dowels	Screws or Bolts	Other	Not Known	
Brick									
Brick									
Concrete Block									
Concrete Block									
Reinforced Concrete									
Tilt-up or Precast Concrete									
Steel Studs & Plaster									
Wood Studs & Plaster									
Hollow Tile									
Hollow Tile & Plaster									

NOTE: Wall Rating on Basis of A, B, C, and X.

FORM FMB-1

FIELD EVALUATION METHOD

OTHER LIFE HAZARDS - EARTHQUAKE RATING

TYPE OF RISK	RATING
Partitions Other Than on Corridors or Stair Enclosures	
Glass Breakage	
Ceiling	
Light Fixtures	
Exterior Appendages and Wall Cladding*	

Ratings
A = Good
B = Fair
C = Poor
X = Unknown

*A description of some of the ratings for Exterior Appendages and Wall Cladding are:

Description	Rating
Spacing of anchors appears satisfactory	A
Size and embedment of anchors satisfactory	A
Spacing of anchors appears to be too great	B
Size and embedment of anchors appears unsatisfactory	C
Anchorage unknown	X
Anchorage corroded or obviously loose	C
No anchorage	C

EARTHQUAKE GAS CONNECTION		
Present	Not Present	Not Known

FACILITY NO.______________

FIELD EVALUATION METHOD

STRUCTURAL SYSTEM - WIND RATING

BUILDING DESIGNATION:										
* Exposure A, B or C	* Basic Wind Speed (V_2)	Building Height	* Effective Velocity Pressure (q_F)	**** Design Unit Pressure $q_F x1.4=P$	** Basic Structural Rating	Uplift Anchorage Factors: Foundation	Uplift Anchorage Factors: Roof	*** Corrected Structural Rating	Effective Unit Velocity Pressure Capacity P_c	Capacity Ratio $\frac{P}{P_c}$

* See ANSI A58.1-72. q_F in pound per square foot.
** From Structural Systems - Form FME.
*** Use Maximum Anchorage Factor (Foundation or Roof) or the Basic Structural Rating, whichever is greater.
**** q_F x 1.3 = P for buildings with height to length ratio less than 2.5.

ANCHORAGE FACTORS

BUILDING TYPE	UPLIFT ANCHORAGE TO FOUNDATION	FOUNDATION ANCHORAGE FACTOR[1]	UPLIFT ANCHORAGE OF ROOF	ROOF ANCHORAGE FACTOR[1]
Heavy Buildings	Good	1.0	Good	1.0
Heavy Buildings	Poor	1.5	Poor	4.0
Light Buildings	Good	1.0	Good	1.0
Light Buildings	Poor	4.0	Poor	4.0

CORRECTED STRUCTURAL RATING	P_c
1. -	45
1.1 to 1.5	40
1.6 to 2.0	30
2.1 to 3.0	20
3.1 to 3.5	10
3.6 to 4.0	5

[1] Factors should be increased 0.5 (not to exceed 4.0) if the building is primarily un-enclosed.

FORM FMC-1

FIELD EVALUATION METHOD

OTHER LIFE HAZARDS - WIND RATING

TYPE OF RISK	RATING
Glass Breakage	
Window Frame Anchorage	
Roof Panel Anchorage	
Wall Panel Anchorage	
Anchorage of Exterior Appendages	

A = Good; B = Fair; C = Poor; X = Unknown.

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE

TYPE	QUANTITY	DISTANCE

FACILITY NO. ____________ FORM FMD

FIELD EVALUATION METHOD

TORNADO RATING

EFFECTIVE UNIT VELOCITY PRESSURE CAPACITY P_c (From FMC-1)	DOES BUILDING QUALIFY AS A VAULT-TYPE STRUCTURE?		TORNADO RATING BUILDING-AS-A-WHOLE
	Yes ☐	No ☐	

BUILDING-AS-A-WHOLE RATINGS

Vault Type Building - Good
P_c = 40 p.s.f. or over - Fair
P_c = 20 to 40 p.s.f. - Poor
P_c = Under 20 p.s.f. - Very Poor

HAZARD FROM WIND-BLOWN DEBRIS				
	LOCATION	TYPE	NOT PRESENT	RATING
Wall Cladding, Appendages, or Glass				
Other Potential Debris Not Part of The Building				

WIND-BLOWN DEBRIS RATINGS

Not Present - Good
Small Quantity of Potential Hazard - Fair
Large Quantity of Potential Hazard - Poor

BASEMENT STORM SHELTER AVAILABILITY	
Present	Yes ☐ No ☐
Capacity*	
Suitability**	

*Based on 15 sq. ft. per person.

**See section 3.2E.

FIELD EVALUATION METHOD

CAPACITY RATIOS - EARTHQUAKE AND WIND RATING

	General Rating (GR)	Sub-Rating SR1	Sub-Rating SR2	Basic Structural Rating*	Capacity Ratio**
EARTHQUAKE					
WIND					

*Basic Structural Rating = $\frac{\text{GR} + 2\ (\text{Largest of SR1 or SR2})}{3}$.

**Capacity Ratio for wind shall be obtained from Form FMC-1. For earthquake, the ratio is obtained from the Basic Structural Rating divided by the Intensity Level Factor at the site as determined from the table below.

Modified Mercalli Scale	Intensity Level Factor
VIII or Greater	1
VII	2
VI	3
V or Less	4

A description of Modified Mercalli Scale is included on table 3.3.

Capacity Ratio Rating	
Capacity Ratio	Rating (In Terms of Risk)
Less than 1.0	Good
1 through 1.4	Fair
1.5 through 2.0	Poor
Over 2.0	Very Poor

APPENDIX C

APPROXIMATE ANALYTICAL EVALUATION METHOD

C.1 GENERAL PROCEDURES IN EVALUATING BUILDING FOR EARTHQUAKE HAZARD USING THE APPROXIMATE ANALYTICAL EVALUATION METHOD

The plans should be checked with the Data Collection Form to see if they represent the "as built" structure and that any additions and alternations are incorporated in the plans.

The site seismicity, based on anticipated ground motion for the design earthquake or earthquakes, would be obtained by assigning the factor Z_c or calculating the factor Z_s.

The original design calculations may or may not be available. If they are available they may have followed code criteria other than 1973 UBC [2.5], in which case all its provisions may not be incorporated into the building. Procedures in checking where seismic design calculations are available will vary somewhat from procedures where they are not available.

Calculations Available

1. Check seismic zone used (Z_c which is the code zone factor Z).
2. Check type of structure and type of framing to see if proper K values have been used (Table 23-1 of [2.5]).
3. Check whether the structure is highly irregular. Does it have setbacks or highly dissimilar stiffness of vertical resisting elements at various levels. Setbacks are covered in Paragraph (i) and Exception 2 to equation 14-2 [2.5]. These are quoted in section 3.3.
4. Check calculation for "T" and determine if "ZKC" has been properly determined (Equations 14-2, 1403, [2.5]).
5. Check calculations for typical dead loads (W) to assure that no important item has been omitted or a decimal point misplaced. (Note that partition loads are dead loads.)
6. Check if base shear, V, is properly computed and distributed. (Equation 14-1, [2.5]).
7. See is proper distribution of horizontal forces has been made from top to bottom of structure as per equations (14-4) and (14-5) of Chapter 23 of UBC.
8. Check lateral force resisting system and the paths of resistance used to see if the assumptions made are reasonable. Check whether the horizontal diaphragms are capable of distributing lateral forces to the vertical resisting elements. This, of course, should be checked for loads in both directions. If vertical resisting elements are not continuous from upper levels to lower levels, make sure that the diaphragms and struts are capable of redistributing the lateral forces. This is for a general check of the system of lateral resistance used.

9. See if relative rigidities of the vertical elements have been considered and whether torsional effects have been considered. It should be kept in mind that a flexible horizontal diaphragm will not transfer lateral loads to vertical elements in proportion to their relative rigidities. (See section 3.3B for quotations from the Tri-Service Manual [3.1] regarding diaphragm flexibility.) Neither will a flexible horizontal diaphragm distribute torsional forces without excessive deformations.

10. Assuming that the calculations have been consistent with code requirements and that the items above listed have been reasonably considered, check unit stresses in the vertical and horizontal resisting elements for the forces assumed. If not, additional calculations may be required to evaluate items not covered. All the elements need not be checked. For instance, in a shear wall resisting system, the stiffest pier or wall element will usually have the highest unit stresses. Sufficient checks with assistance from eyeball interpolations or extrapolation should be made to ascertain critical elements. In multi-story buildings, the top and bottom stories and, say, at least one intermediate story between should be checked. Where multi-story moment resisting frames are used, the logical check levels would be at the lower story of a column section where changes occur. Steel column sections are usually maintained constant for two or three stories.

11. The overturning calculations should be reviewed to determine if properly carried out and the foundations and soil pressures checked for total compression or net tension adequacy.

12. Drift calculations are not necessary on one or two story buildings with reinforced concrete or masonry shear walls. Tall buildings using moment resistant frames or obviously flexible type buildings should be checked for story to story drift to determine compatibility with nonstructural items but this information will not be needed for structural system evaluation.

13. Determine the critical stress ratio (f_e/f_a) based on the Z_c used in the original calculations. This ratio shall be modified by Z_s/Z_c if the site seismicity is different from that used in the original design. These items are summarized on Form AMA.

Calculations Not Available

Where calculations are not available, it will be necessary to make sufficient calculations to determine the building's resistance capacity.

1. Determine the appropriate seismic zone factor as discussed previously.

2. Proceed as described in "Calculations Available" (starting with Item 2) except that calculations are made instead of checked. Calculations to determine the forces to be applied to the building for a static analysis should be complete. Stress analysis need be only as complete as in the checking analysis previously described in paragraph entitled "Calculations Available." The critical element stresses are determined and the critical stress ratio (f_e/f_a) calculated as in Item 13 above.

Exit Corridor and Stair Enclosure Walls

The failure of brittle masonry walls surrounding exit corridors and stairs may cause loss of life in a severe earthquake. The evaluation of such enclosure walls and their anchorage should be given special attention. The evaluation of these elements will be indicated on Form AMB-1. The forces to be used in analysis are those for the applicable portions of buildings as described below.

Portions of Buildings

Parts or portions of buildings and their anchorage should be analyzed for lateral forces in accordance with the formula $F_p = Z_s C_p W_p$. Table No. 23-J of 1973 UBC [2.5] gives the value for C_p with applicable footnotes. Some of the items involved here are important in that life hazards are involved. Falling parapets or appendages on a public way, for instance, constitute such a hazard and a separate rating form (AMB-2) is provided for noting any non-compliance.

C.2 GENERAL PROCEDURES IN EVALUATING BUILDINGS FOR WIND HAZARD USING THE APPROXIMATE ANALYTICAL EVALUATION METHOD

The plans should be checked with the Data Collection Form to see if they represent the "as built" structure. Proceed as follows:

1. Determine the Basic Wind Speed assigned to the site.

2. Determine the Effective Velocity Pressure (qp) from table 5 of ANSI [3.2] and the External Pressure Coefficients from table 7.

3. Make a pressure diagram for the building as a whole.

4. If original wind calculations are available, check these pressures obtained from ANSI Tables with the pressures originally calculated.

5. Check the adequacy of the horizontal distribution system (diaphragms) to distribute wind forces to the vertical resisting elements.

6. Check the adequacy of the vertical resisting elements for shear and axial loads. Also check if the center of resistance coincides wity the center of applied wind forces. If there is significant eccentricity in either axis of the building there will be torsion and this should be considered in the check of both horizontal and vertical elements.

7. Determine the Critical Element or Elements and the Critical Stress Ratio. With this the rating of the Building-As-A-Whole is made on Form AME.

8. Using the coefficients given in ANSI 6.5.3.2 [3.2], check for uplift on the roof.

9. Check exposed elements for positive or negative pressures.

10. Check Anchorage of exposed elements, such as Wall Panels, Wall Cladding, and appurtenances such as Canopies.

11. Check the Anchorage of such elements as Window Frames, Wall Cladding and Exterior Appendages and determine the Critical Stress Ratio for these anchors. From this a rating can be placed for these items on Form AMC-2.

12. Check the DC Form for presence and distance of Potential Windblown Debris and note same on Form AMC-2.

13. Check the adequacy of Window Glass and Glazing for the pressures noted and rate these items on Form AMC-2.

C.3 GENERAL PROCEDURE IN EVALUATING BUILDING FOR TORNADO HAZARD USING THE APPROXIMATE ANALYTICAL EVALUATION METHOD

Check the plans with the Data Collection Form to see that the plans represent the "as built" structure. Proceed as follows:

1. Calculate the wind forces on the building as a whole using 80 p.s.f. on the windward side and 60 p.s.f. on the leeward side. Use a suction force on all exposed roofs or horizontal areas of 172 p.s.f. The stresses on various resisting elements produced by these forces is f_T. These stresses (f_T) will be related to a design ultimate capacity of the resisting systems.

   The ultimate capacity of the elements is used for f_a tornado because of the relatively short duration of full tornado forces and the limited area over which these forces would act at any one instant of time. Since the tornado forces assumed are rough estimates, it is felt that the use of ultimate capacities of resisting elements is warranted.

   The stress (f_a) is the capacity of the member in excess of that required to support the gravity loads. f_a at the ultimate capacity of the members shall be based on the values indicated in the following table:

MATERIAL	BASIS FOR STRESS AT ULTIMATE CAPACITY
Concrete	ACI 318-71 [C.1]
Structural Steel	Part 2, AISC 1969 Specifications [C.2]
Light Gauge Steel	1.7 times AISI 1968 Specifications [C.3]
Aluminum	1.7 times 1967 Specifications of The Aluminum Association [C.4]
Masonry[a]	2.0 times UBC 1973 [2.5]
Wood[a,b]	2.5 times UBC 1973 [2.5]
a. Other Code or Specifications containing working stress material capacities may be used.	
b. When data is based on the inclusion of the 1/3 increase on working stresses for wind or earthquake loading (such as diaphragms) the multiplier is reduced by (2.5/1.33) = 1.9.	

2. Calculate the effect of uplift on exposed roof areas considering the weight of the roof.

3. (a) Check capability of roof and floor systems to transmit lateral forces to vertical resisting elements. This includes anchorage check.

   (b) Calculate the critical stress ratio, f_T/f_a, on critical elements.

4. (a) Check capability of vertical elements such as shear walls or moment resisting frames to deliver forces to the foundations. This includes a check of the anchorage of these elements to foundations.

   (b) Calculate the critical stress ratio, f_T/f_a, on critical elements.

5. (a) Check capability of foundations to resist net forces of sliding, overturning, and suction.

   (b) Calculate the critical stress ratio, f_T/f_a, on critical elements.

6. Note any special cases such as large canopies or roof structures. These should be checked for capacity to withstand these forces.

7. Check strength and anchorage of wall cladding and appendages. If the stress, f_T, is less than f_a, they will be considered adequate. If not, they will be considered inadequate. These are the only ratings.

8. Check strength and anchorage of doors and glazed areas. The same assumptions and ratings as given in Item 7 will apply to glass panes and their frames and attachments, and to doors and their attachments.

The critical stress ratios, f_T/f_a, are approximate indicators of the ability of a building to withstand tornadoes. The real capacity of the element may vary from f_a, but the degree of variation is dependent on the materials considered. Consistency in quality and workmanship, in accuracy in load calculations, and uncertainty in loads influences the reliability of f_T.

Since failure of any of the resisting systems could cause failure of the entire structure, the final building rating is based on the lowest of any of the systems.

Damaged Elements

Where any of the resisting elements are found to be badly cracked, bent, or otherwise severely damaged, they may very well fail under tornado loadings. If such a member is critical to the system it should be field evaluated and its computed capacity arbitrarily reduced by judgment.

Debris

The presence or non-presence of potential wind blown debris in the area outside the facility can be noted on the rating form. If such potential wind blown missiles are observed in the area, the box marked "Present" should be checked; otherwise, check "Not Present." If the "Present" box is checked, a supplemental note describing the material and its general location should be attached to the rating form.

C.4 INSTRUCTIONS FOR THE APPROXIMATE ANALYTICAL EVALUATION METHOD RATING FORMS

FORM AMA-1 - Structural Systems - Earthquake

In the first column, "Type of Frame," enter the applicable letter from the list of types given below.

The second column is headed "Type of Diaphragm." Enter in this column the type of material the diaphragm consists of, such as reinforced concrete, metal deck, wood floor, precast concrete units, etc.

In the column headed "Modified Mercalli Scale Intensity," enter the MMI for the site if explicitly assigned by the user or determined using the concepts of section 3.4. For example. Eqs. (3.4.2) and (3.4.3) relate MMI to a selected earthquake magnitude and hypocentral distance.

In the next column, the "Z_s" factor should be entered as determined from the formula given in the paragraph entitled Site Seismicity for the Approximate Analytical Method in section 3.3. The "Z_c" factor on which the original calculations were based should be entered in the next column. If calculations were for the site "Z_s" factor, enter this also in the "Z_c" column. If no Z_s is determined, enter Z_c in the "Z_s" column.

In the "Critical Elements" column, there are two items. Under "Type," designate the kind of element such as column, beam, girder, truss, or shear wall. Under "Location," give the location such as "1st Floor," "3rd Floor," etc.

In the last column "Critical Stress Ratio," enter the ratio f_e/f_a modified by Z_s/Z_c. This should be done for the various critical elements analyzed so that the greatest f_e/f_a ratio can be readily selected. The greatest critical stress ratio is transferred to Form AME to determine rating for earthquake.

FORM AMB-1 - Exit Corridors and Stair Enclosure Walls - Earthquake:

Most of the types of walls commonly used are listed on this form. More than one type of wall may be used for this purpose in any one building. In the column under "reinforcement," place a check in the appropriate subcolumn as to whether or not reinforcement is present on the type of wall being considered. For wood or steel stud types of walls, leave the "reinforcement" column blank.

Under "Anchorage," place a check in one of the sub-columns opposite the type of wall being considered. If a check is placed in the sub-column labeled "Other," describe this briefly below the table or on a supplementary sheet.

In the "Critical Stress Ratio" column, enter the ratio of stresses in these as determined by analyzing these walls and anchorages for lateral forces, both normal and parallel to the walls.

The "rating" for these exit corridor and stair enclosure walls is taken from the table on Form AME entitled "Rating of Critical Stress "Ratios" and entered in the last column.

FORM AMB-2 - Other Life Hazards - Earthquake:

The critical stress ratio for members and anchorages for the items listed on this form are determined and entered opposite the appropriate types of risk. With these ratios, determine the proper rating from the table on AME entitled "Rating of Critical Stress Ratios" and note this rating in the "Rating" column.

FORM AMC-1 - Structural Systems - Wind:

The rating of the building as a whole is determined by the ratio of the stresses (f_w) resulting from the design pressure to the material design stresses (f_a) - including 33-1/3% increases where permitted. A rating form (AMC-1) has been provided for this. The "Building Designation" is given at the top of sheet. In the first column, list "Exposure A, B, or C" conforming to ANSI designations. In the second column, fill in the "Basic Wind Speed" assigned to the site. This is assumed to be for the 50-year mean recurrence interval. If any other recurrence interval is used, such as the 100-year recurrence interval, it should be noted in parenthesis - (100). In the third column give the height of the building and in the fourth give "Effective Velocity pressure" as determined from table 5 of ANSI [3.2].

In the "Critical Elements" column, list the type and location. The type might be "Column" and the location "1st Story." Or the type might be "large brick pier" with location given as "front wall, second story."

Compute the critical stress ratio and enter it in the column provided.

The "Basic Wind Speed Capacity" is a measure of the capability of the building given as a wind speed at 30 feet above ground. This speed can be used to assess the general capability of the building to resist wind forces but is not used as a rating. The stress-ratio factor "f_w/f_a" gives the relation between the stresses resulting from design pressure and the material design stresses in excess of that required to support gravity loads. Since wind velocity is a function of the square root of the pressure, the "Basic Wind Speed (V_1)" can be proportioned to "Basic Wind Speed Capacity (V_2)" by multiplying V_1 by the square root of f_a/f_w. Thus, if the Basic Wind Speed at the site is 100 m.p.h. at 30 feet height, and the inverted stress ratio factor f_a/f_w is 1.4, the Basic Wind Speed Capacity (V_2) will be $100 \times \sqrt{f_a/f_w} = 118$ miles per hour. It should be noted that wind pressures at various heights do not vary in a constant proportion. Therefore, this is only an approximate solution.

FORM AMC-2 - Other Life Hazards - Wind:

Glass Breakage

Table 54-A of the Uniform Building Code [2.5] gives the allowable areas of glass in square feet for various wind loads in p.s.f. up to 100 p.s.f., with required thickness of plate or float glass or sheet glass. Select the proper wind pressure (positive or negative) and check for compliance with this table. The ratings for this item are simply "Compliance" or "Non-Compliance" for the various types of glass, including wired glass, as given in table 54-B "Adjustment Factors" of UBC.

Glazing

Glazing requirements are given in table 54-C of UBC for both doors and windows. The ratings for this item will be "Compliance" or "Non-Compliance."

Window Frame Anchorage

The applicable wind pressure is distributed to the anchors and the stress in the anchors determined based on the anchorage pattern. The stress in the anchor produced by the wind is compared with the allowable design stress in the anchor to determine the critical stress ratio.

Wall Cladding Anchorage

The applicable wind pressure on the cladding is determined. The wind force (positive or negative) assigned to the anchors can then be computed, considering their spacing and location. Except for extremely light wall claddings, such as 16 gage sheet metal or under, the vertical loads on the anchors should also be considered in the computations. The stresses so computed in the anchors or in the material to which the anchors are connected are then compared with the allowable design stresses to obtain the critical stress ratio.

Anchorage of Exterior Appendages

The anchorage of exterior appendages can be computed and rated as described for "Wall Cladding Anchorages."

Exposed Walls

The maximum wind pressure, either positive or negative, applied normal to the wall, is used for the appropriate heights above ground. Such walls are checked as vertical slabs and may be considered as one-way slabs or two-way slabs with or without continuity as the situation may warrant. The stress ratio is then computed. The rating is obtained from the table at the bottom of Form AMC-2.

The walls at corners of the building for a horizontal width equal to 1/10 of the least width of the building should be checked for a suction equal to twice the effective velocity pressure in a similar manner.

These ratings are entered in the appropriate boxes.

Canopies and Eaves

Where these occur, they will be checked for an uplift force of 0.7 times the effective velocity pressure and the critical stress ratio computed. From this, the rating is obtained from the lower table and entered in the appropriate box. The dead load of canopies and eaves should be subtracted from the uplift force.

Potential Missiles from Outside of Structure

This item is noted but not rated. See section 3.2D on potential wind blown missiles in the Field Evaluation Method. This is based on field observations only. Under "Type", note the type of material in the adjacent area that might be wind blown. Under "Quantity", note "large" or "small. Under "Distance", note the approximate distance of the potential missile material from the structure being evaluated.

FORMS AMD-1 AND AMD-2 - Tornadoes:

Reference is made to section C.3 "General Procedure in Evaluating Building for Tornado Hazard." The Critical Stress Ratios "f_T/f_a" are determined as described therein. These ratios are then placed in the appropriate spaces after each of the "Systems" listed. The highest critical stress ratio of any of these Systems is used to fill in the space after "Tornado" in the upper table on Form AME. The Tornado Ratings for various Critical Stress Ratios are given in the table "Rating of Critical Stress Ratios" on Form AME.

On Form AMD-2, the strength and anchorage of Wall Cladding and Appendages is analyzed as described in section C.3, and the rating "Adequate or Inadequate" entered in the appropriate space. Similarly the strength and anchorage of glazed areas is determined and rated in the adjoining space.

For Exposed Walls use the maximum wind pressures, either positive or negative applied normal to the walls. This is 80 psf on the windward side and 50 or 60 psf on the leeward side depending on the height-to-width ratio of the building (ANSI, 6.3.4.1. [3.2]) Check these walls as vertical slabs as given in the Instructions for Wind and compute the Critical Stress Ratio. The rating is then obtained from the table at the bottom of Form AMD-2 and placed in the appropriate box. No special consideration is given to corner walls.

For Canopies and Eaves, these elements are checked for uplift values of 172 p.s.f. as for roofs. Dead loads should be subtracted. The Critical Stress Ratio for these elements is computed and the rating obtained from the table at the bottom of the form. The rating is placed in the proper box.

Potential Missiles from Outside of Structure

The presence or non-presence of potential wind blown debris is taken from the Data Collection Form and noted in the table near the bottom of this form.

FORM AME - Structural Systems Rating Form - Earthquake, Wind, Tornado:

This form relates the Critical Stress Ratios to final ratings for Structural Systems and is for the hazards of earthquake, wind, and tornado. The Critical Stress Ratios for Structural Systems are taken from the applicable Approximate Analytical Method Forms for the hazards being considered and placed in the second column. The "Rating" is then taken from the table below. This table gives different ratings for Tornado than for Earthquake and Wind. In the tornado ratings ("good," "fair," etc.), consideration has been given to the probability of a direct hit by a tornado over the entire structure and to the fact that these extremely high forces are in effect for only a few seconds.

C.5 EVALUATION FORMS AMA TO AME

The following pages contain the above noted forms.

FACILITY NO. ______________ FORM AMA-1

APPROXIMATE ANALYTICAL METHOD
STRUCTURAL SYSTEMS - EARTHQUAKE RATING

BUILDING DESIGNATION:							
Type of Frame	Type of Diaphragm	Modified Mercalli Intensity	Z_s	Z_c	Critical Elements		Critical Stress Ratio (f_e/f_a)
					Type	Location	

TYPE

A Steel Moment Resistant Frames
B Steel Frames - Vertical Load Carrying Only
C Concrete Moment Resistant Frames
D Concrete Frames - Vertical Load Carrying Only
E Masonry Shear Walls - Unreinforced
F Masonry or Concrete Shear Walls - Reinforced
G Combination - Unreinforced Shear Walls and Moments Resistant Frames
H Combination - Reinforced Shear Walls and Moment Resistant Frames
J Braced Frames
K Wood Frame Buildings, Walls Sheathed or Plastered
L Wood Frame Buildings, Walls Without Wood Sheathing or Plaster
M Other

Z_s = Zone factor determined for site from Modified Mercalli Intensity.

Z_c = Zone factor from Code.

NOTE: For rating of Structural Systems, use Form AME.

FACILITY NO. ______________

APPROXIMATE ANALYTICAL METHOD
EXIT CORRIDOR AND STAIR ENCLOSURE WALLS - EARTHQUAKE RATING

Type of Wall	Reinforcement		Anchorage				Critical Stress Ratio f_e/f_a	Rating*
	Present	Not Present	Mortar Only	Dowels	Screws or Bolts	Other		
Brick								
Brick								
Concrete Block								
Concrete Block								
Reinforced Concrete								
Tilt-up or Precast Concrete								
Steel Studs & Plaster								
Wood Studs & Plaster								
Hollow Tile								
Hollow Tile & Plaster								

*Obtained from Form AME - Rating of Critical Stress Ratios.

FORM AMB-1

FACILITY NO. ______________ FORM AMB-2

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - EARTHQUAKE RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING*
Partitions Other Than on Corridors or Stair Enclosures		
Exterior Appendages and Wall Cladding		
Ceiling		
Light Fixtures		

*See Form AME - Rating of Critical Stress Ratios.

FACILITY NO. ____________

APPROXIMATE ANALYTICAL METHOD
STRUCTURAL SYSTEMS - WIND RATING

BUILDING DESIGNATION:

Exposure A,B,or C	Basic Wind Speed* V_1	Building Height	Effective Velocity Pressure q_F	Design Unit Pressure q_Fx1.4=P or q_Fx1.3=P	Critical Elements		Critical Stress Ratio f_w/f_a	Basic Wind Speed Capacity $V_2 = V_1\sqrt{f_a/f_w}$
					Type	Location		

*See ANSI A58.1-72

f_w = Stress resulting from design pressures.
f_a = Allowable Material stress (x 1.33 where applicable)

NOTE: For rating of Structural Systems, use Form AME.

FORM AMC-1

FACILITY NO. ________________ FORM AMC-2

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - WIND RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING
Glass Breakage*	------	
Glazing*	------	
Window Frame Anchorage		
Wall Cladding Anchorage		
Anchorage of Exterior Appendages		
Exposed Walls		
Canopies and Eaves		

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE*

TYPE	QUANTITY	DISTANCE

*See Instructions for ratings.

CRITICAL STRESS RATIO	RATING
< 1.0	Good
1.0 to 1.5	Fair
> 1.5	Poor

FACILITY NO. ________________ FORM AMD-1

APPROXIMATE ANALYTICAL METHOD
RATING FORM - TORNADOES

SYSTEMS CRITICAL STRESS RATIOS*

SYSTEM	f_T/f_a **
Roof	
Roof Anchorage	
Floor	
Floor Anchorage	
Vertical Resisting Element	
Anchorage to Footings	
Footings	

*Use highest Critical Stress Ratio.
For Structural Systems Rating - Tornado, see Form AME.

**f_T = Capacity required to resist tornado forces.
f_a = Capacity based on design criteria.

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - TORNADO RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING
Glass Breakage*		
Glazing*		
Window Frame Anchorage		
Wall Cladding Anchorage		
Anchorage of Exterior Appendages		
Exposed Walls		
Canopies & Eaves		

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE*

TYPE	QUANTITY	DISTANCE

*See Instructions for ratings.

CRITICAL STRESS RATIO	RATING
< 2.0	Good
2.0 to 3.0	Fair
> 3.0	Poor

FACILITY NO. ______________ FORM AME

APPROXIMATE ANALYTICAL METHOD
CRITICAL STRESS RATIOS - STRUCTURAL SYSTEMS

	Critical Stress Ratio	Rating
Earthquake		
Wind		
Tornado		

RATING OF CRITICAL STRESS RATIOS

Critical Stress Ratio	Earthquake or Wind	Tornado
Less than 1.0	Good	Good
1 to 1.5	Fair	Good
1.5 to 2.0	Poor	Good
2.0 to 3.0	Very Poor	Fair
3.0 to 4.0	Very Poor	Poor
Over 4.0	Very Poor	Very Poor

APPENDIX D

EXAMPLES

D.1 INTRODUCTION

This appendix presents nine example problems. The examples are intended to familiarize the reader and user with the methods presented in chapter 3. Section D.2 presents a Field Evaluation Method example, sections D.3 and D.4 present solutions using the Approximate Analytical Evaluation Method, and the Detailed Analytical Evaluation Method is applied to several building structures in section D.5 and D.6.

D.2 EXAMPLE 1

A. Preamble

The example selected here is an old two-story building with exterior, unreinforced brick masonry walls, a wood roof and a wood second floor. It is located on a corner with the front and one side facing streets. The rear faces an alley and the other side is on a property line. The front wall has very large glass display windows in the first story and a large glass area in the second story. The side wall facing the street also has large glass areas; the other two walls are nearly solid. The wood roof and floor systems are not properly anchored to provide adequate diaphragms.

The rating forms have been devised to assist in evaluating such factors as mentioned above. Since plans were not available for this building it is rated only by the Field Evaluation Method. It is rated for Earthquake, Wind, and Tornado. Since the Wind rating is rather poor, the rating for Tornado is somewhat unnecessary but this has been included to demonstrate the use of the Field Evaluation Method Forms.

B. Data Collection Form

The Data Collection Form containing Sheets 1-DC-1 to 1-DC-12 has been completed for the building in Example 1 and is included in this section.

DATA COLLECTION FORM
NATURAL HAZARDS EFFECTS
(Extreme Winds, Earthquakes)

A. GENERAL DATA

*1. Facility No. ________ 2. Building Name EXAMPLE 1

3. Address — 4. City —

5. State — 6. Zip Code — 7. Year Built —

8. Date of Major Modifications or Additions, if any —

9. Building Code Jurisdiction: City [✓] County [ ] State [ ] Federal [ ]

*10. Latitude — *11. Longitude —

12. Current Bldg. Use LIGHT MFG. Orig. Bldg. Use UNKHOWN

13. Basement Yes ____ No ✓ Number of Basements ________

No. of Stories Above Basement 2 (See also Item A23)

14. Height of First Story 15 ft.

15. Upper Story Height 11 ft. Special Story Height ________ ft.

16. Is the exterior of first story different from upper stories?

Street Front Side Yes ✓ No ____ Other Sides Yes ✓ No ____

17. Approximate Roof Overhang Distance NONE Side NONE

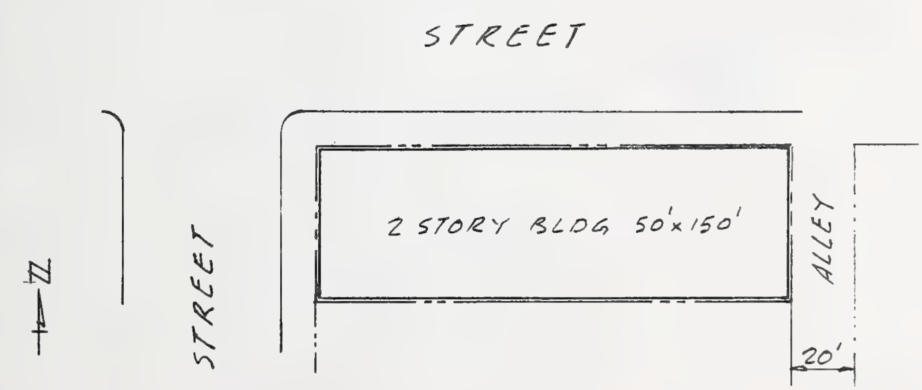
18. Proximity to Adjacent Buildings: Sketch Below with North Arrow

North Side 70' South Side ϕ East Side 20' West Side 70'

Note Street or Alley Sides ________

*To be filled in by Field Supervisor.

Sketch



19. Are plans available? NO If so, where obtainable ______________ ______________ Are original calculations available? NO If so, where obtainable ______________

Name of: Architect UNKNOWN Engineer UNKNOWN

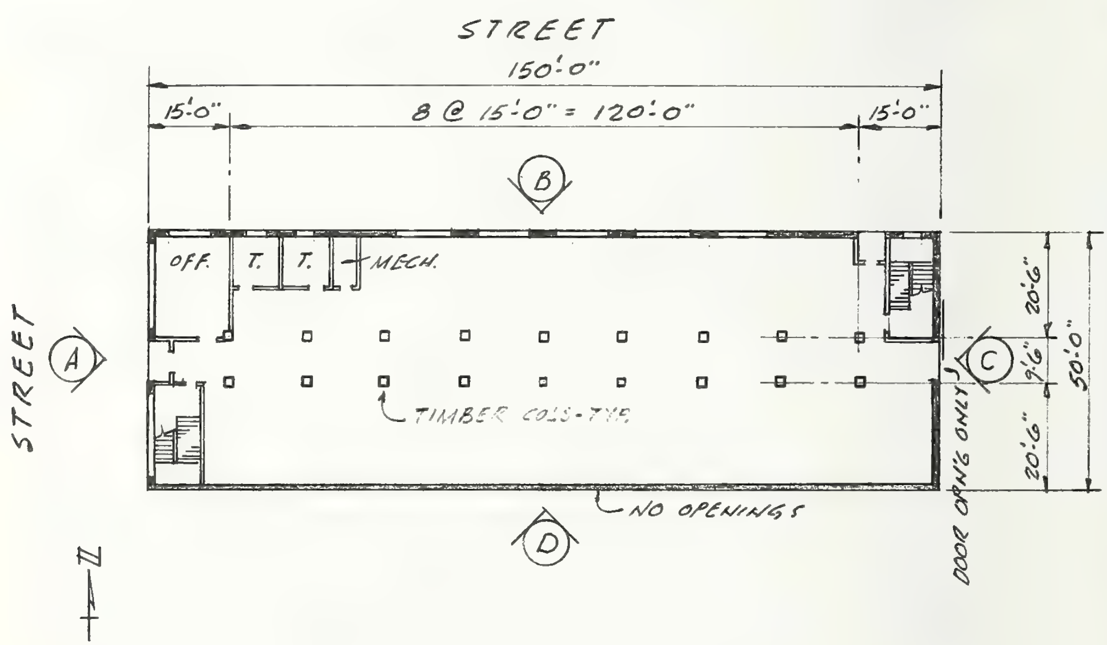
Contractor UNKNOWN

Regulatory Agency CITY

20. Basic Building Plan

a. Sketch overall plan.
b. Locate shear walls, if any.
c. Locate main frames.
d. Locate expansion joints, if any.
e. Give approximate north arrow and label sides "A", "B", "C", "D", etc. Show street or alley sides.
f. Note any common or party walls.
g. If plan changes in upper floors, sketch this plan and note level of change.

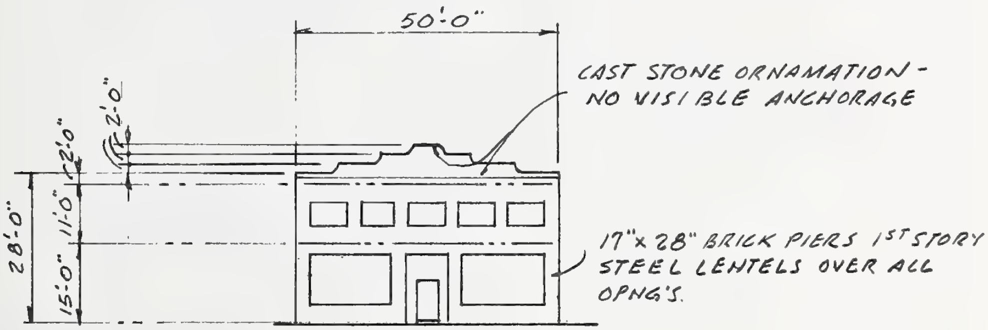
(Use additional sheet if necessary)



21. Elevation of Exterior Walls.

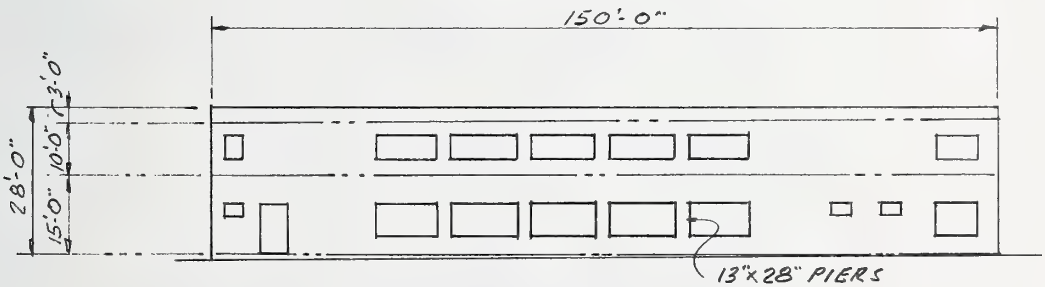
Sketch:
- a. All openings or note pattern of openings.
- b. Note exterior finish and appendages.
- c. Note material of walls.
- d. Major cracks or other damage. (Note if cracks are larger at one end.)
- e. Note previously repaired damage.
- f. Note any evidence of damage to cladding or appendages.

(Use additional sheet if necessary)



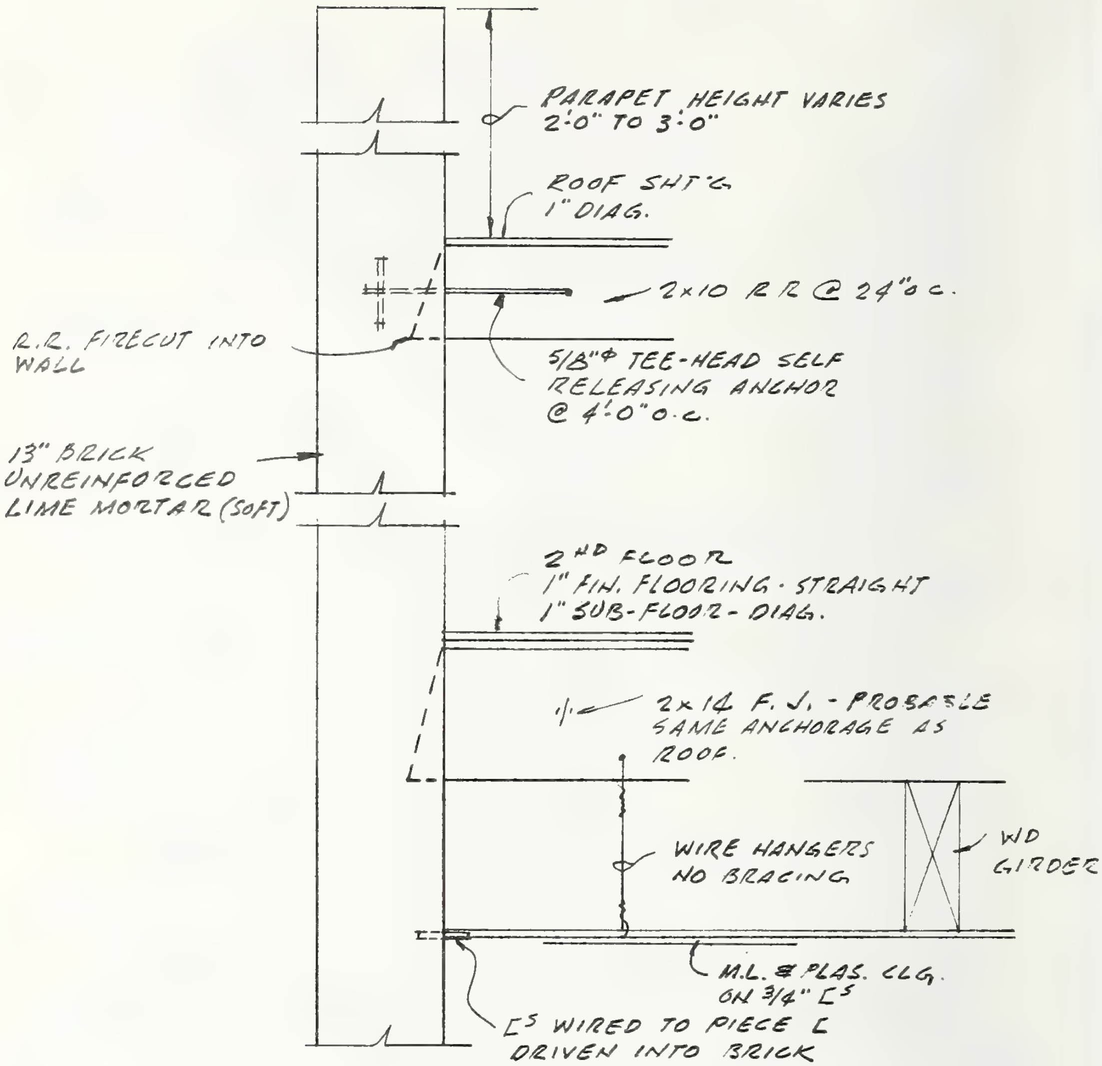
NOTE: EXTERIOR WALLS 13" BRICK - UNREINFORCED. LIME MORTAR - SOFT.

ELEVATION "A"



NOTE: EXTERIOR WALLS 13" BRICK - UNREINFORCED. LIME MORTAR - SOFT.

ELEVATION "B"



TYPICAL WALL SECTION

22. Elevation of Interior Shear Walls. NONE

Sketch: a. All openings.
b. Major cracks or other damage. (Note if cracks are larger at one end.)
c. Note any previously repaired damage.

23. Adaptability of Basement to Storm Shelter. NO BASEMENT

a. Floor Over Basement - Concrete ☐ Other ☐

b. If concrete, give thickness ________

c. Available Space (approximate) ______________ sq. ft.

d. Dangerous Contents. Storage of Flammable Liquids ☐

Presence of Transformers or Other Dangerous Equipment ☐

Other Hazards ____

None ☐

24. Is this a Vault-like Structure? Yes ☐ No ☑

25.

EXTERIOR WALL SUMMARY SHEET

Exterior Characteristics	Side A	Side B	Side C	Side D
Extensive Architectural Ornaments or Veneer	✓			
WALLS Metal Curtain Wall				
Precast Concrete Curtain Wall				
Stone				
Brick	✓	✓	✓	✓
Concrete Block				
Concrete				
Other				
For Concrete Block and Brick, indicate R for Running Bond S for Stacked Bond	R	R	R	R
Condition of Wall*	2	2	2	2
OPENINGS Percent of Open Area per Story	2ND = 30% 1ST = 60%	2ND = 21% 1ST = 26%	2ND = 0% 1ST = 8%	2ND = 0% 1ST = 0%

*1. No cracks, good mortar.
2. Few visible cracks.
3. Many cracks
4. Evidence of minor repairs.
5. Evidence of many repairs.

B. SITE RELATED INFORMATION

1. Exposure

   a. Centers of large city ☐ b. Very rough hilly terrain ☐

   c. Suburban areas, towns, city outskirts, wood areas, or rolling terrain ☑ d. Flat, open country ☐

   e. Flat coastal belts ☐ f. Other ☐

2. Topography

   a. Building on level ground ☑ b. Building on sloping ground ☐

   c. Building located adjacent to embankment ☐

*3. Geologic formation —

*4. Location of known faults: Name — Miles —

   ______ Miles ______

*5. Depth of water table — ft. When measured: — (Month) — (Year)

*6. Depth of bedrock — ft.

*7. Soil type —

*8. Bearing capacity — p.s.f., or — blows per inch

9. Proximity to potential wind-blown debris - Type LUMBER

   Location LUMBER YARD TO THE NORTH Distance 100'

*To be filled in by Field Supervisor.

C. STRUCTURAL SYSTEMS

1. Material

Concrete [ ] Masonry [x] Steel [ ] Wood [ ]

2. Vertical Load Resisting System

Frame [ ] Bearing Wall [ ] Wall and Pilasters [x]

For frame system, check one for typical column cross-section

[x] [ ] [ ] [ ] Other [ ]

3. Lateral Load Resisting System

Masonry Shear Wall [x]
Concrete Shear Wall [ ]
Plywood Shear Wall [ ]
Braced Frame [ ]
Moment Resisting Frame [ ]
Are resisting systems symmetrically located? Yes [ ] No [x]

4. Floor System

Frame

Concrete Beams [ ]
Steel Beams [ ]
Steel Bar Joist [ ]
Wood Beams [x]
No Framing Members [ ]
Precast Concrete Beams [ ]

Deck

Concrete Flat Plate [ ]
Concrete Flat Slab [ ]
Concrete Waffle Slab [ ]
Steel Deck [ ]
Wood Joists [x]
Wood Plank [ ]
Straight Sheathing [x]
Plywood Sheathing [ ]
Diagonal Sheathing [x]
Precast Concrete Deck [ ]
Concrete Joists [ ]
Concrete Plank [ ]

Note if concrete topping slab is used over metal decks or concrete plank.

Connection Details

	Framing	Decking To Framing
Bolted	✓	
Welded		
Metal Clips		
Wire Fastener		
No Connection		
Nailed	✓	✓
Metal Hangers	✓	

Anchorage Floor to Walls

Type COULDN'T SEE - PROBABLY SAME AS ROOF

Spacing ______

5. Roof System

Frame

Concrete Beams		Steel Truss	
Steel Beams		Wood Truss	
Steel Bar Joist		No Framing Members	
Wood Beams	✓	Precast Concrete Beams or Tees	
Wood Rafters	✓		

Deck

Concrete Flat Slab		Concrete Waffle Slab	
Metal Decking		Plywood Sheathing	
Concrete Slab		Diagonal Sheathing	✓
Concrete Joists		Straight Sheathing	
Precast Decking		Concrete Fill	Yes ☐ No ✓

Connection Details

	Framing	Decking to Framing
Bolted	✓	
Welded		
Metal Clips		
Wire Fastener		
No Connection		
Nailed	✓	✓
Metal Hangers	✓	

Anchorage Roof to Walls

Type 5/8"φ TEE HEADED SELF RELEASING ANCHOR

Spacing 4'-0" o.c.

D. NONSTRUCTURAL ELEMENTS

1. Partitions

Type

	Typical	Corridor
Partial Height		
Full Height Floor-To-Ceiling		
* Floor To Floor	✓	✓
Movable		

Composition

Lath and Plaster	✓	ON WOOD STUDS
Gypsum Wallboard		
Concrete Block		
Clay Tile		
Metal Partitions		

* STUD WALLS IN UPPER STORY NAILED TO RAFTERS AND BLOCKING, 1ST STORY WALLS PROBABLY ARE SIMILARLY NAILED BUT NOT VISIBLE.

2. Ceiling

Typical Room

Material

Acoustical Tile [ ] Gypsum Board [ ] Plaster [x]

Method of Attachment

Suspended [ ] Metal Channels [x] Tee Bar Grid [ ]

Attached Directly to Structural Elements [ ]

Typical Corridor

Material

Acoustical Tile [ ] Gypsum Board [ ] Plaster [x]

Method of Attachment

Suspended [ ] Metal Channels [x] Tee Bar Grid [ ]

Attached Directly to Structural Elements [ ]

3. Light Fixtures

Typical Room

Recessed [x] Surface Mounted [ ] Pendant (Suspended) [ ]

Typical Corridor

Recessed [x] Surface Mounted [ ] Pendant (Suspended) [ ]

4. Mechanical Equipment

Location of Mechanical Equipment Room

Basement [ ] Other Floor [x] Which Floor 1ST

Roof [ ]

Is Equipment Anchored to Floor? No [x] Yes [ ]

Location of The Following Units

Liquid Storage Tank NONE

Cooling Tower NONE

Air Conditioning Unit WINDOW UNITS

5. Roofing

Description

Flat ☑ Arched ☐ Gabled ☐ If arched or gabled, sketch section.

Pitched ☐ Slope (:12)

Parapet No ☐ Yes ☑ Height (2' TO 3' (SEE SKETCH & ELEVATIONS) ft. ____ in.) Thickness (13 in.)

Material MASONRY Special Anchorage or Bracing Yes ☐ No ☑

Type

Built-up gravel ☑ Gravel ☐ Asphalt or Wood Shingles ☐

Clay Tile ☐ Other ☐

6. Windows

Type

Fixed ☑ (LOWER STORY - WALL A Movable ☑ ALL OTHERS

Frame Material:

Aluminum ☐ Steel ☑ Stainless Steel ☐ Wood ☐

Size: Average Size of Casing (____ ft. x ____ ft.) SEE ELEVATIONS

Average Size of Glazing (____ ft. ____ in. x ____ ft. ____ in.)

How Casing is Attached to Structure

Bolted ☐ Screwed ☐ Clipped ☐ Welded ☐ Nailed ☐ IMBEDDED IN MASONRY

Glazing Attachment to Casing

Elastomeric Gasket ☐ Glazing Bead ☑ Aluminum or Steel Retainer ☐

Other ☐

7. Gas Connection

Flexible Connection to Building ☐ Rigid Connection to Building ☑

Automatic Shut-off ☐ None ☑ Unknown ☐

INSPECTED BY ____________

DATE ____________

FIELD SUPERVISOR ____________

C. EARTHQUAKE EVALUATION

The mortar on this building was picked with a knife and found to be soft lime mortar. There was no ceiling in the upper story so the roof construction could be seen. The type of roof anchorage could also be seen and it is assumed that the second floor anchorage is similar. A sketch was made of this detail in the Data Collection Form.

It is noted that Wall D has no openings. This is probably a property line wall. Wall C has only one opening. The other two walls have many openings. A steel plate could be seen over the large windows of Wall A with rivet heads, showing that this plate must be attached to a steel lintel beam.

The 1" diagonal roof sheathing indicates that the roof diaphragm is quite flexible. There are no interior masonry walls, so the diaphragm must span between exterior walls and will be unable to transfer any significant torsional effects. The lateral loads then will be resisted by the exterior wall vertical elements and the lateral loads to each wall will be tributary loads. Thus, the obviously critical wall will be Wall A in the lower story, where there are only four 17" x 28" brick piers. The difference in rigidity between Wall A and Wall C is noted in the Symmetry Rating.

The second floor diaphragm consists of both straight sheathing and diagonal sheathing. This combination produces a more rigid diaphragm than the single diagonal sheathed roof. This is taken into consideration in the rigidity ratings given on 1-Form FMA-2.

Some explanation of the ratings given for "Other Life Hazards" should be given. Under "Partitions Other Than on Corridors and Stair Enclosures," a rating "A" has been given. On 1-DC-10 the partitions are noted to extend full height floor to floor. This could be seen in the upper story and it is probable that this occurs in the first story.

The "Glass Breakage" item is rated "C." The large, front, plate glass windows are very vulnerable. The casing has a projection that appears to be embedded in the masonry. There is no provision for lateral movement in the plane of the glass. Thus, it is anticipated that this glass would crack and shatter if this building were subjected to a strong earthquake.

The "Ceiling" item is rated "B." There was no bracing found, but it is probable that the metal channels are nailed to the wood girders.

"Light Fixtures" are rated "C." They are recessed and no special bracing was noted.

The rating "X" for the cast stone ornamentation on Wall A is because the anchorage is unknown.

A resume of the Field Evaluation is given on 1-Form FME.

1—FORM FMA-1

FACILITY NO. EXAMPLE 1 SITE MODIFIED MERCALLI INTENSITY VIII

FIELD EVALUATION METHOD

STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

VERTICAL RESISTING ELEMENTS							
Type	General Rating (GR) E	General Rating (GR) W	Symmetry (S)	Quantity (Q)	Symmetry Quantity Rating (SQR)	Present Condition (PC)	Sub-Rating (SR1)
TRANSVERSE LOADING							
E	4	3	4	2	3.0	2	2.3
LONGITUDINAL LOADING							
E	4	3	3	1	2.0	2	2.0

NOTES: Symmetry-Quantity Rating (SQR) = $\frac{S + Q}{2}$.

Sub-rating SR-1 = $\frac{SQR + 2PC}{3}$.

	TYPE	GENERAL RATING (GR) Earthquake	Wind
A	Steel Moment Resistant Frames	1	1
B	Steel Frames - Moment Resistance Capability Unknown	2	2
C	Concrete Moment Resistant Frames	1	1
D	Concrete Frames - Moment Resistance Capability Unknown	2	2
E	Masonry Shear Walls - Unreinforced	4	2 or 3
F	Masonry or Concrete Shear Walls - Reinforced	1	1
G	Combination - Unreinforced Shear Walls and Moment Resistant Frames	2	2
H	Combination - Reinforced Shear Walls and Moment Resistant Frames	1	1
J	Braced Frames	1	1
K	Wood Frame Buildings, Walls Sheathed or Plastered	1 or 2	2 or 3
L	Wood Frame Buildings, Walls Without Wood Sheathing or Plaster	4	4

SYMMETRY (of Resisting Elements)

1	Symmetrical
2	Fairly Symmetrical
2 or 3	Symmetry Poor
3 or 4	Very Unsymmetrical

NOTE: Add 1 (not to exceed 4) to each rating if a high degree of vertical non-uniformity in stiffness occurs.

QUANTITY (of Resisting Elements)

1	Many Resisting Elements
2	Medium Amount of Resisting Elements
3	Few Resisting Elements
4	Very Few Resisting Elements

NOTE: If exterior shear walls are at least 75% of building length, this rating will be 1.

PRESENT CONDITION (of Resisting Elements)

1	No Cracks, No Damage
2	Few Minor Cracks
3	Many Minor Cracks or Damage
4	Major Cracks or Damage.

NOTE: If masonry walls, note quality of mortar - good or poor. If lime mortar is poor, use next higher rating.

FACILITY NO. *EXAMPLE 1* 1 - FORM FMA-2

FIELD EVALUATION METHOD

STRUCTURAL SYSTEMS - EARTHQUAKE AND WIND RATING

HORIZONTAL RESISTING ELEMENTS						
Type		Rigidity (R)	Anchorage & Connections (A)	Chords (C)		Sub-Rating (SR2)
				Longitudinal	Transverse	
Roof	A	2.5	2	4	4	4.0
Floors	A	2.0	2	4	4	4.0

Note: Sub-rating SR2 = Largest of R, A or C.

Type
A Diaphragm
B Steel Horizontal Bracing

Rigidity - Ratings
1. Rigid
1.5 Semi-rigid
2.0 Semi-flexible
2.5 Flexible

Anchorage and Connections - Ratings
1 Anchorage confirmed - capacity not computed, but probably adequate.
2 Anchorage confirmed - capacity not computed, but probably inadequate.
3 Anchorage unknown.
4 Anchorage absent.

Chords - Ratings
1 Chords confirmed, but capacity not computed.
2 Chords unknown, but probably present.
3 Chords unknown, but probably not present.
4 Chords absent.

FACILITY NO. *EXAMPLE 1*

1 - FORM FMB-1

FIELD EVALUATION METHOD

EXIT CORRIDOR AND STAIR ENCLOSURE WALLS - EARTHQUAKE RATING

TYPE OF WALL	REINFORCEMENT			ANCHORAGE					WALL RATING
	Present	Not Present	Not Known	Mortar Only	Dowels	Screws or Bolts	Other	Not Known	
Brick									
Brick									
Concrete Block									
Concrete Block									
Reinforced Concrete									
Tilt-up or Precast Concrete									
Steel Studs & Plaster									
Wood Studs & Plaster								✓	X
Hollow Tile									
Hollow Tile & Plaster									

NOTE: Wall Rating on Basis of A, B, C, and X.

1-FORM FMB-1

FACILITY NO. *EXAMPLE 1* *1-* FORM FMB-2

FIELD EVALUATION METHOD

OTHER LIFE HAZARDS - EARTHQUAKE RATING

TYPE OF RISK	RATING
Partitions Other Than on Corridors or Stair Enclosures	A
Glass Breakage	C
Ceiling	B
Light Fixtures	C
Exterior Appendages and Wall Cladding*	X

Ratings
A = Good
B = Fair
C = Poor
X = Unknown

*A description of some of the ratings for Exterior Appendages and Wall Cladding are:

Description	Rating
Spacing of anchors appears satisfactory	A
Size and embedment of anchors satisfactory	A
Spacing of anchors appears to be too great	B
Size and embedment of anchors appears unsatisfactory	C
Anchorage unknown	X
Anchorage corroded or obviously loose	C
No anchorage	C

EARTHQUAKE GAS CONNECTION		
Present	Not Present	Not Known
	✓	

D. Wind Evaluation

The same Data Collection Form material is as applicable for wind evaluation as for earthquake. A basic wind speed of 100 miles per hour is assumed with Exposure "B." Because of the light roof and its poor anchorage, and its poor basic structural rating of 3, the "Effective Velocity Pressure Capacity" is relatively low. The information necessary for evaluation of the structural system is given with the earthquake evaluation on 1-Form FME. A resume of the field evaluation is given in section D.2F.

FACILITY NO. EXAMPLE 1 — 1- FORM FMC-1

FIELD EVALUATION METHOD

STRUCTURAL SYSTEM - WIND RATING

BUILDING DESIGNATION:

* Exposure A, B or C	* Basic Wind Speed (V_2)	Building Height	* Effective Velocity Pressure (q_F)	**** Design Unit Pressure q_Fx1.4=P	** Basic Structural Rating	Uplift Anchorage Factors: Foundation / Roof	*** Corrected Structural Rating	Effective Unit Velocity Pressure Capacity P_c	Capacity Ratio $\frac{P}{P_c}$
B	100	28'	16	22.4	3.7	1.5 / 4.0	4.0	5	4.5

* See ANSI A58.1-72. q_F in pound per square foot.
** From Structural Systems - Form FME.
*** Use Maximum Anchorage Factor (Foundation or Roof) or the Basic Structural Rating, whichever is greater.
**** q_F x 1.3 = P for buildings with height to length ratio less than 2.5.

ANCHORAGE FACTORS

BUILDING TYPE	UPLIFT ANCHORAGE TO FOUNDATION	FOUNDATION ANCHORAGE FACTOR[1]	UPLIFT ANCHORAGE OF ROOF	ROOF ANCHORAGE FACTOR[1]
Heavy Buildings	Good	1.0	Good	1.0
Heavy Buildings	Poor	1.5	Poor	4.0
Light Buildings	Good	1.0	Good	1.0
Light Buildings	Poor	4.0	Poor	4.0

CORRECTED STRUCTURAL RATING	P_c
1. -	45
1.1 to 1.5	40
1.6 to 2.0	30
2.1 to 3.0	20
3.1 to 3.5	10
3.6 to 4.0	5

[1] Factors should be increased 0.5 (not to exceed 4.0) if the building is primarily un-enclosed.

1- FORM FMC-1

FACILITY NO. EXAMPLE 1 1- FORM FMC-2

FIELD EVALUATION METHOD

OTHER LIFE HAZARDS - WIND RATING

TYPE OF RISK	RATING
Glass Breakage	B
Window Frame Anchorage	B
Roof Panel Anchorage	C
Wall Panel Anchorage	—
Anchorage of Exterior Appendages	X

A = Good; B = Fair; C = Poor; X = Unknown.

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE

TYPE	QUANTITY	DISTANCE
LUMBER YARD	LARGE	100'

E. Tornado Evaluation

Evaluation of this structure utilizes the same Data Collection material as for earthquake and wind. It is obvious that this building does not conform to the requirements of a Vault-Type structure. Because of the light roof, its poor anchorage and its poor structural rating, the "Effective Velocity Pressure Capacity" is very low (see 1-Form FMC-1) and the tornado rating of the building as a whole is "very poor." The anchorage of the cast stone ornamentation on the front of the building is unknown and rated "Fair." As noted on the Data Collection Form, there is a lumber yard close by which could be a source of danger from windblown debris. There is no basement available as a storm shelter.

FIELD EVALUATION METHOD

TORNADO RATING

EFFECTIVE UNIT VELOCITY PRESSURE CAPACITY P_c (From FMC-1)	DOES BUILDING QUALIFY AS A VAULT-TYPE STRUCTURE?		TORNADO RATING BUILDING-AS-A-WHOLE
5	Yes ☐	No ☑	VERY POOR

BUILDING-AS-A-WHOLE RATINGS

Vault Type Building - Good
P_c = 40 p.s.f. or over - Fair
P_c = 20 to 40 p.s.f. - Poor
P_c = Under 20 p.s.f. - Very Poor

HAZARD FROM WIND-BLOWN DEBRIS				
	LOCATION	TYPE	NOT PRESENT	RATING
Wall Cladding, Appendages, or Glass	APPENDAGES ON FRONT OF BLD'G	CAST STONE		FAIR
Other Potential Debris Not Part of The Building	100' NORTH	LUMBER		POOR

WIND-BLOWN DEBRIS RATINGS

Not Present - Good
Small Quantity of Potential Hazard - Fair
Large Quantity of Potential Hazard - Poor

BASEMENT STORM SHELTER AVAILABILITY	
Present	Yes ☐ No ☑
Capacity*	
Suitability**	

*Based on 15 sq. ft. per person.

**See section 3.2E.

F. Resume

COMMENTS ON RATING RESULTS : (For resume of structural systems ratings, see Form FME)

Earthquake

The Field Evaluation Method rates this building "Poor" for its ability to resist an earthquake of MMI VII. It would probably have some structural damage in an earthquake of MMI VI. The wood stud and plaster partitions would probably have little damage in an earthquake of MMI VI but would have some plaster damage in an earthquake of MMI VII, or greater.

The Other Life Hazards, such as the cast stone parapet ornamentation and glass breakage, are rated "Unknown" and "Poor," respectively.

Wind and Tornado

This example rates "Very Poor" under the Field Evaluation Method for a wind of 100 mph wind velocity. Poor roof anchorage is a major factor in this poor rating. The rating would be much better, of course, for winds of, say, 50 mph. Some glass breakage would be expected in the event of 100 mph winds and the large window frames might be damaged.

The Field Evaluation of this example for Tornado would not ordinarily be made where the evaluation for winds of hurricane intensity is "Poor," since the wind pressures from a "moderate" tornado are more severe. The hazard of a nearby lumber yard is noted as a potential source of flying missiles.

FACILITY NO EXAMPLE 1 1- FORM FME

FIELD EVALUATION METHOD

CAPACITY RATIOS - EARTHQUAKE AND WIND RATING

	General Rating (GR)	Sub-Rating SR1	Sub-Rating SR2	Basic Structural Rating*	Capacity Ratio**
EARTHQUAKE	4	2.3	4	4	2.0
WIND	3	2.3	4	3.7	4.5

*Basic Structural Rating = $\frac{\text{GR} + 2\ (\text{Largest of SR1 or SR2})}{3}$.

**Capacity Ratio for wind shall be obtained from Form FMC-1. For earthquake, the ratio is obtained from the Basic Structural Rating divided by the Intensity Level Factor at the site as determined from the table below.

Modified Mercalli Scale	Intensity Level Factor
VIII or Greater	1
VII	2
VI	3
V or Less	4

A description of Modified Mercalli Scale is included on table 3.3.

Capacity Ratio Rating	
Capacity Ratio	Rating (In Terms of Risk)
Less than 1.0	Good
1 through 1.4	Fair
1.5 through 2.0	Poor
Over 2.0	Very Poor

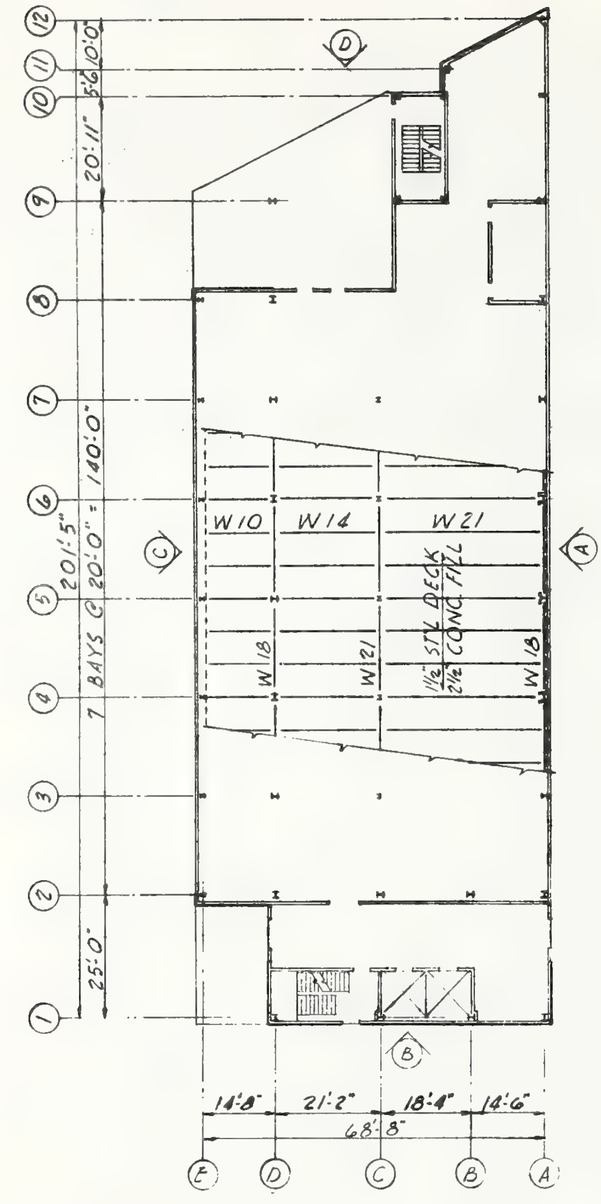
D.3 EXAMPLE 2

A. Preamble

The building chosen for this example is a 6-story steel frame office structure. Steel trusses clear-span the 54 feet building width. For this example, as the plans and calculations were available, only the Approximate Analytical Evaluation Method is used. Some of the pertinent plans follow. The wind calculations were made for low wind pressures. The lateral resistance in the transverse direction is furnished by the truss-column and knee-braced column system acting as moment-resisting frames. In the longitudinal direction, the columns and truss spandrels form a moment-resisting system. The exterior walls are metal studs and plaster. The roof and floor system utilize intermediate steel beams with metal deck and concrete topping.

B. Data Collection Form

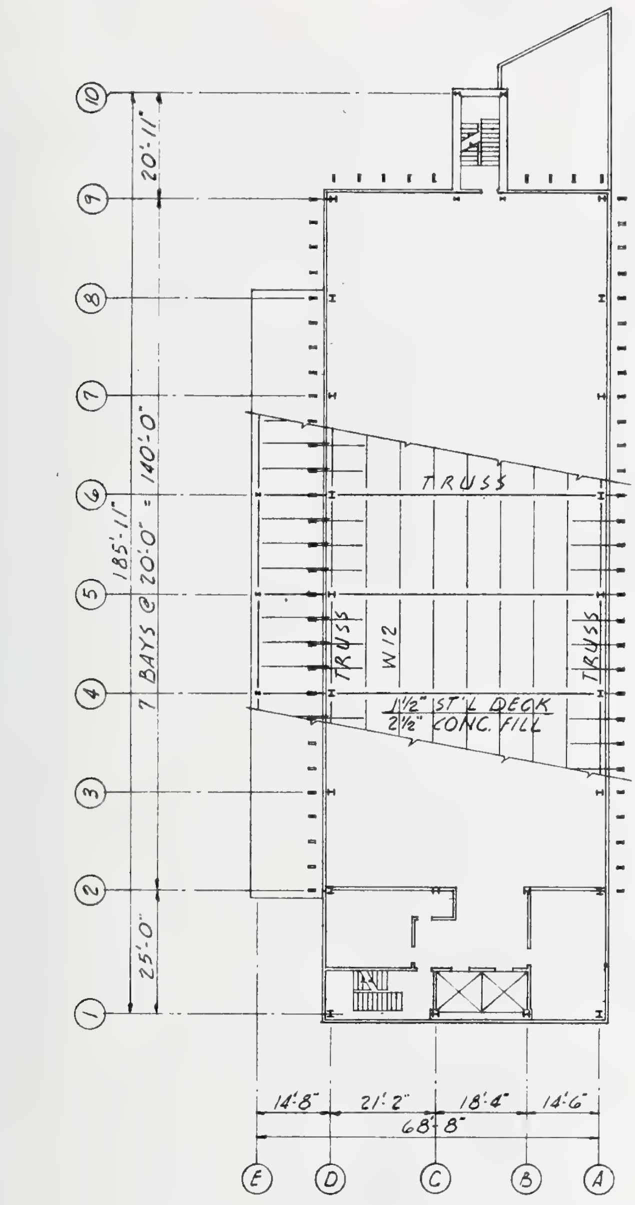
The Data Collection Form containing Sheets 2-DC-1 to 2-DC-12 has been completed for the building in Example 2 and is included in this section.



1ST FLOOR PLAN

FOR USE WITH:
EXAMPLE 2

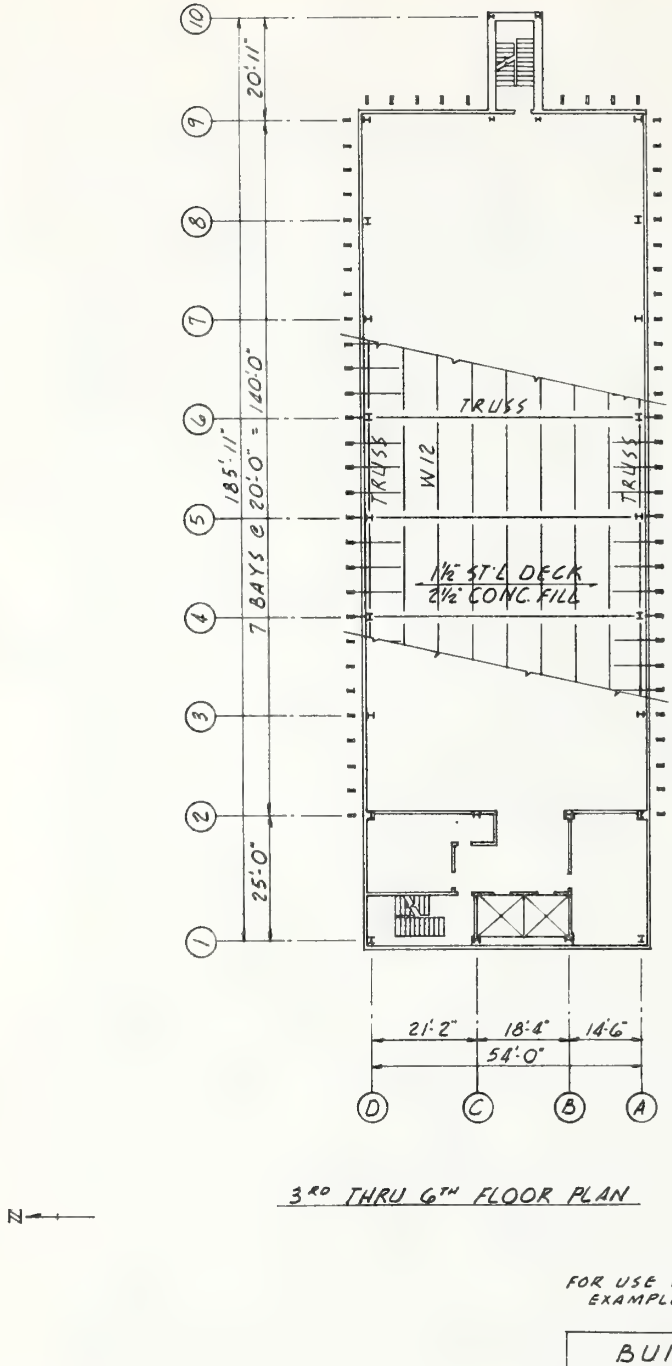
BUILDING Nº 2	SHT
1ST FLOOR PLAN	1



2ND FLOOR PLAN

FOR USE WITH:
EXAMPLE 2

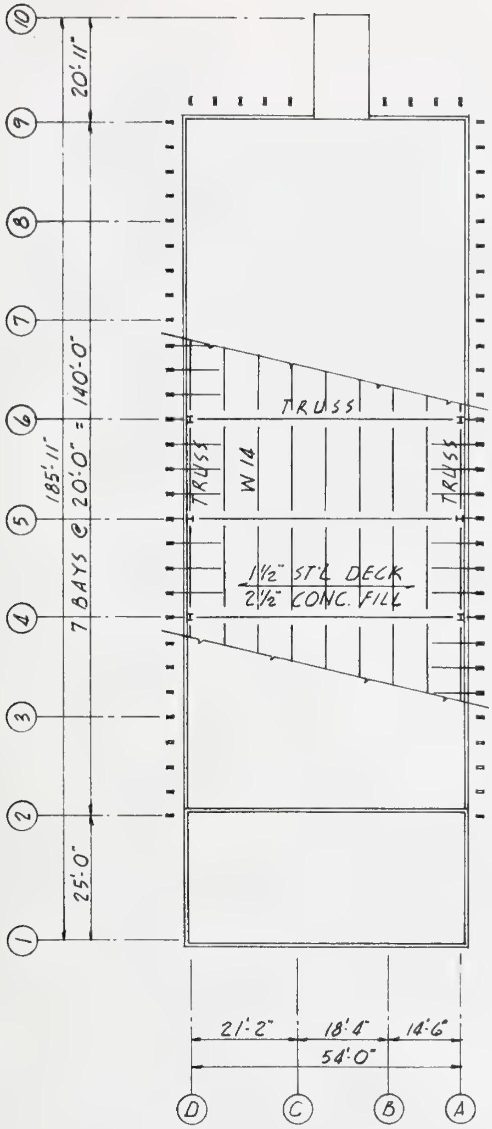
BUILDING Nº 2	SHT
2ND FLOOR PLAN	2



3RD THRU 6TH FLOOR PLAN

FOR USE WITH:
EXAMPLE 2

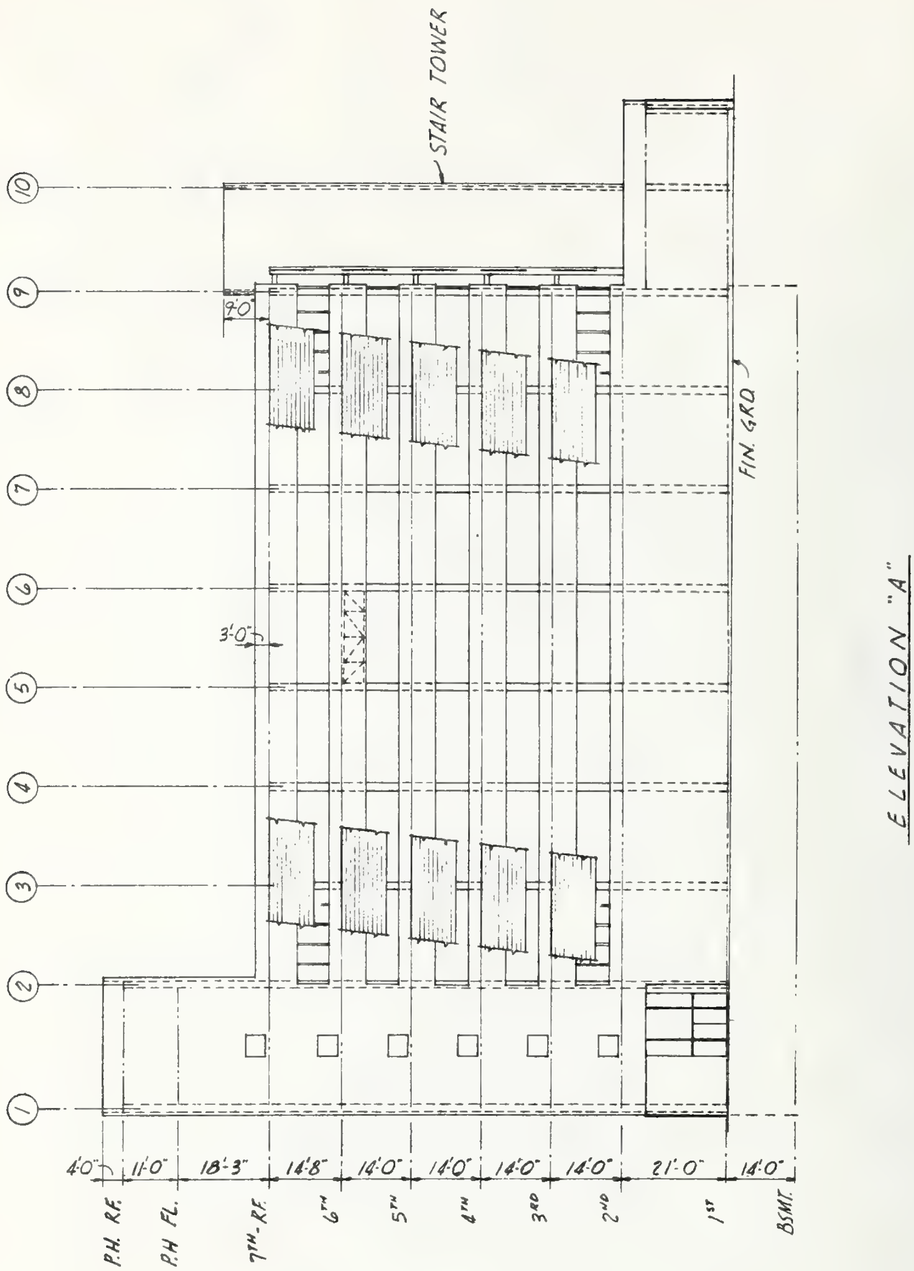
BUILDING Nº 2	SHT
3RD THRU 6TH FLOOR PLAN	3



ROOF PLAN

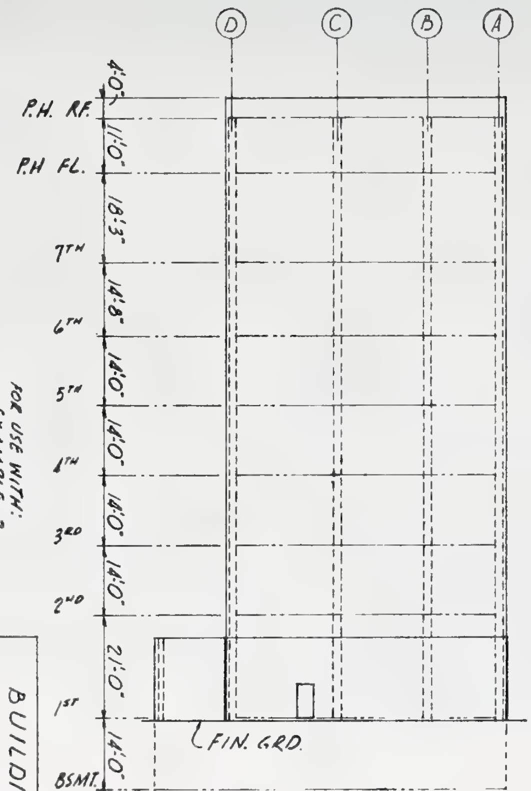
FOR USE WITH:
EXAMPLE 2

BUILDING Nº 2	SHT
ROOF PLAN	4

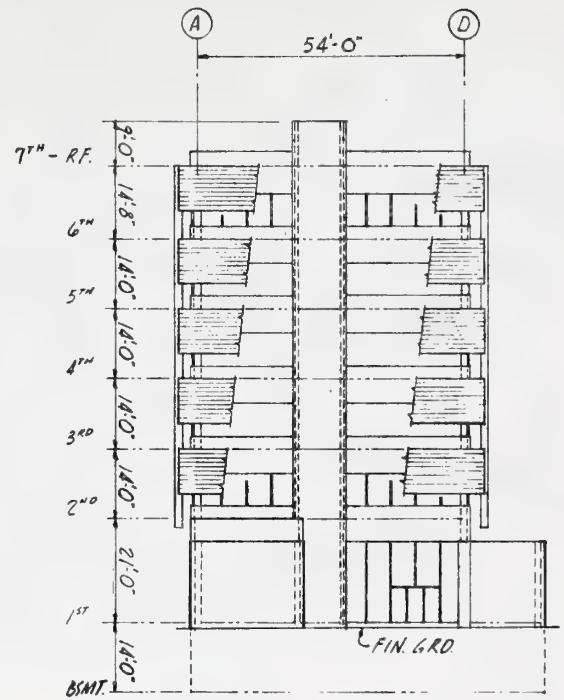


FOR USE WITH:
EXAMPLE 2

BUILDING N° 2	SHT
ELEVATION "A"	5



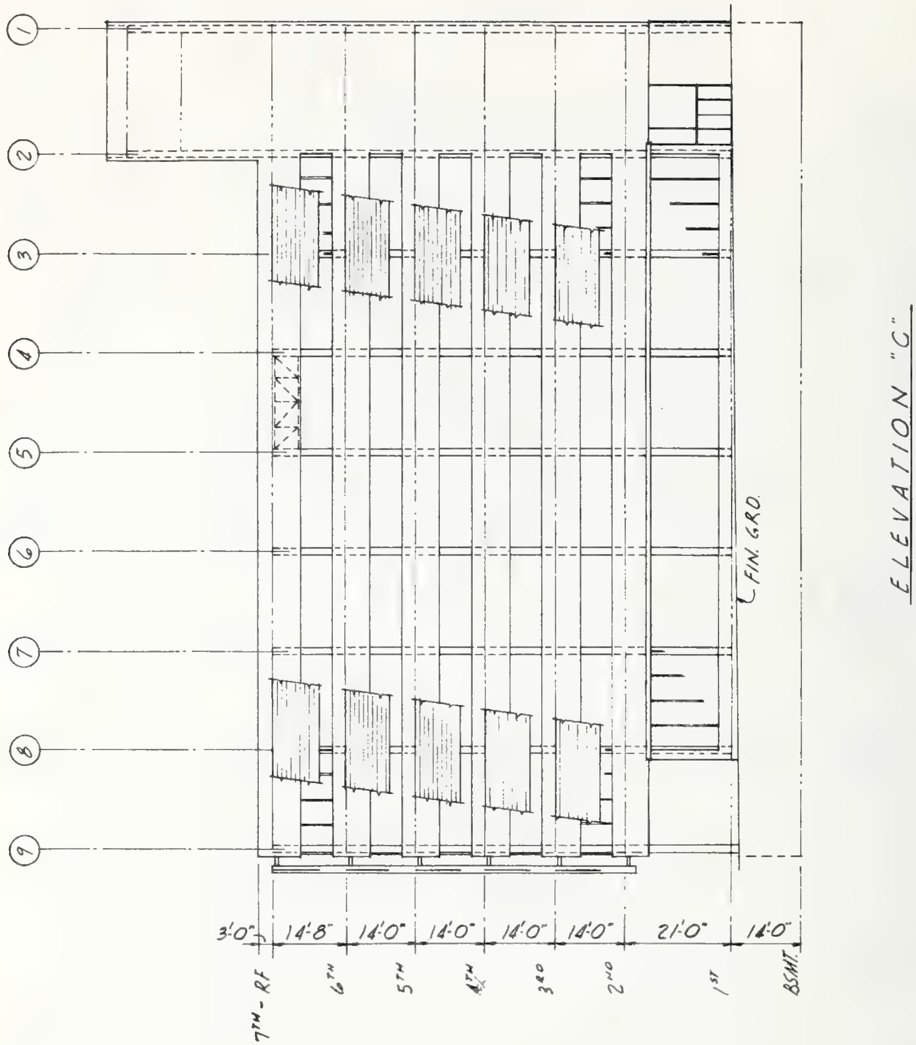
ELEVATION "B"



ELEVATION "D"

FOR USE WITH:
EXAMPLE 2

BUILDING Nº 2	SHT
ELEVATIONS "B" & "D"	6



FOR USE WITH:
EXAMPLE 2

BUILDING Nº 2	SHT.
ELEVATION "C"	7

DATA COLLECTION FORM
NATURAL HAZARDS EFFECTS
(Extreme Winds, Earthquakes)

A. GENERAL DATA

*1. Facility No. — 2. Building Name EXAMPLE 2

3. Address — 4. City —

5. State — 6. Zip Code — 7. Year Built —

8. Date of Major Modifications or Additions, if any —

9. Building Code Jurisdiction: City [✓] County [ ] State [ ] Federal [ ]

*10. Latitude — *11. Longitude —

12. Current Bldg. Use OFFICE Orig. Bldg. Use SAME

13. Basement Yes ✓ No ___ Number of Basements 1

No. of Stories Above Basement 6 (See also Item A23)

14. Height of First Story 21 ft.

15. Upper Story Height 14 ft. Special Story Height NONE ft.

16. Is the exterior of first story different from upper stories?

Street Front Side Yes ✓ No ___ Other Sides Yes ✓ No ___

17. Approximate Roof Overhang Distance NONE Side NONE

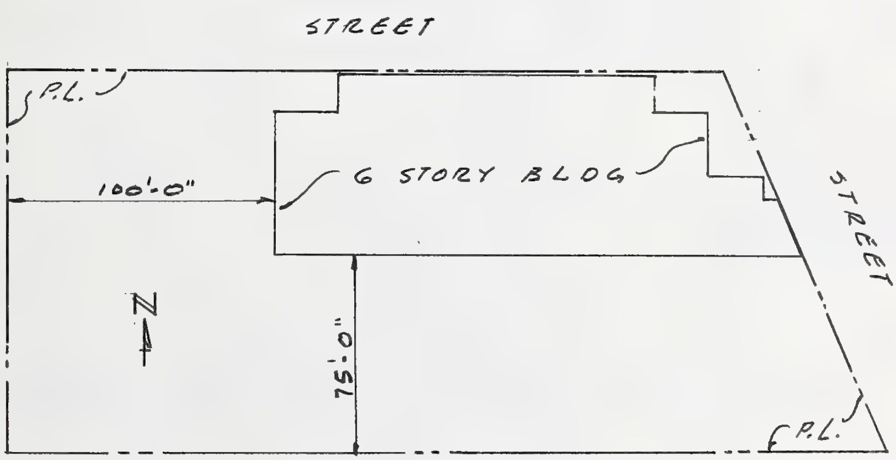
18. Proximity to Adjacent Buildings: Sketch Below with North Arrow

North Side 160' South Side 75' East Side 200' West Side 200'

Note Street or Alley Sides ___

*To be filled in by Field Supervisor.

Sketch



19. Are plans available? YES If so, where obtainable ARCHITECT ____________ Are original calculations available? YES If so, where obtainable ENGINEER

Name of: Architect — Engineer —

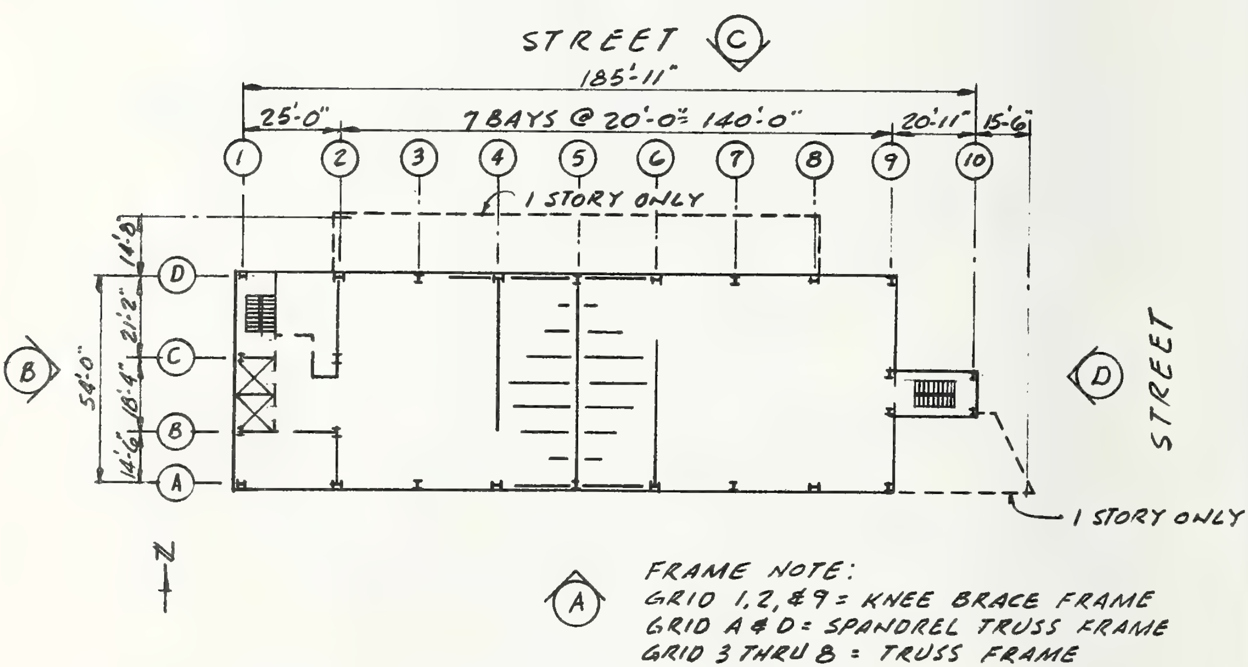
Contractor —

Regulatory Agency CITY

20. Basic Building Plan

a. Sketch overall plan.
b. Locate shear walls, if any.
c. Locate main frames.
d. Locate expansion joints, if any.
e. Give approximate north arrow and label sides "A", "B", "C", "D", etc. Show street or alley sides.
f. Note any common or party walls.
g. If plan changes in upper floors, sketch this plan and note level of change.

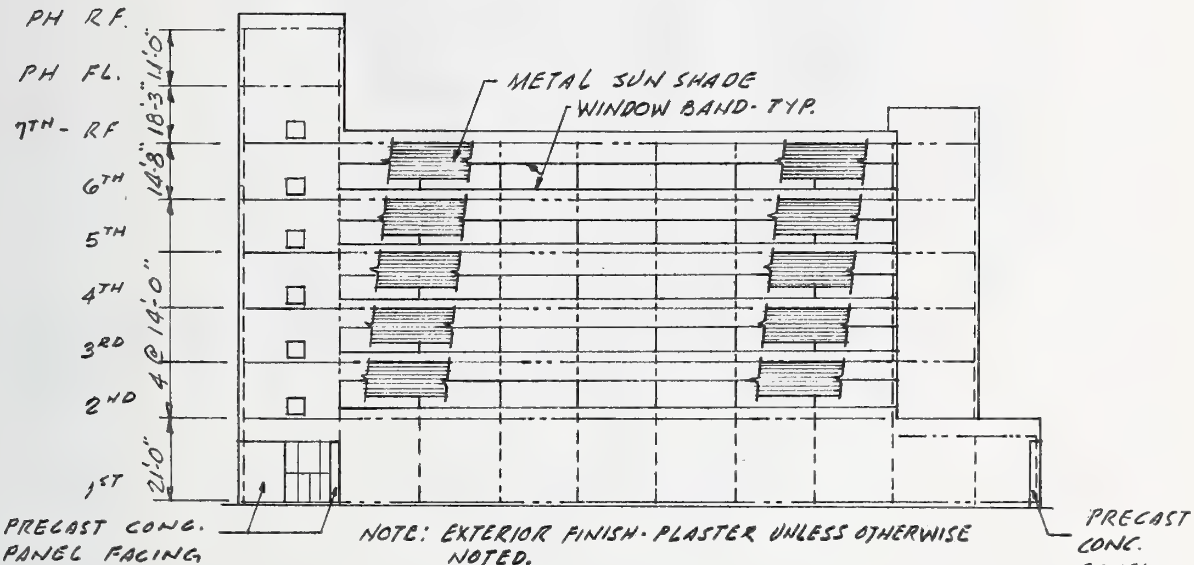
(Use additional sheet if necessary)



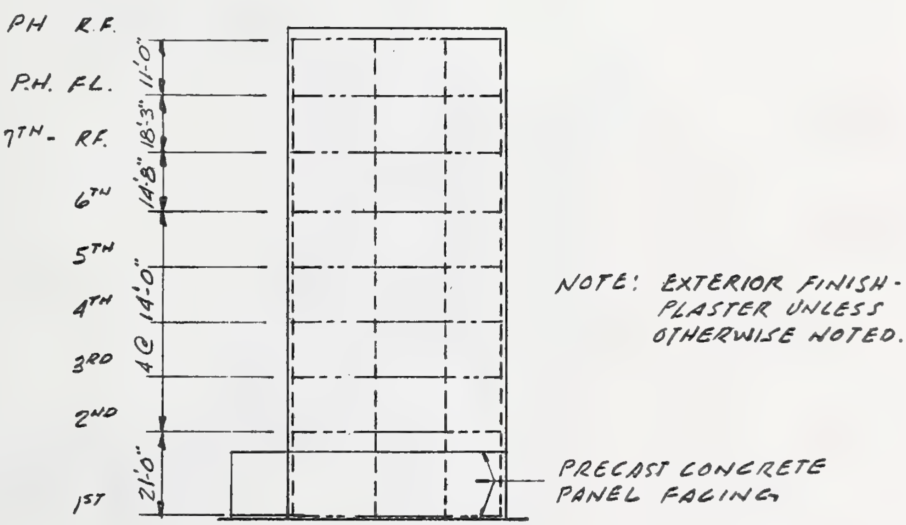
21. Elevation of Exterior Walls.

Sketch:
- a. All openings or note pattern of openings.
- b. Note exterior finish and appendages.
- c. Note material of walls.
- d. Major cracks or other damage. (Note if cracks are larger at one end.)
- e. Note previously repaired damage.
- f. Note any evidence of damage to cladding or appendages.

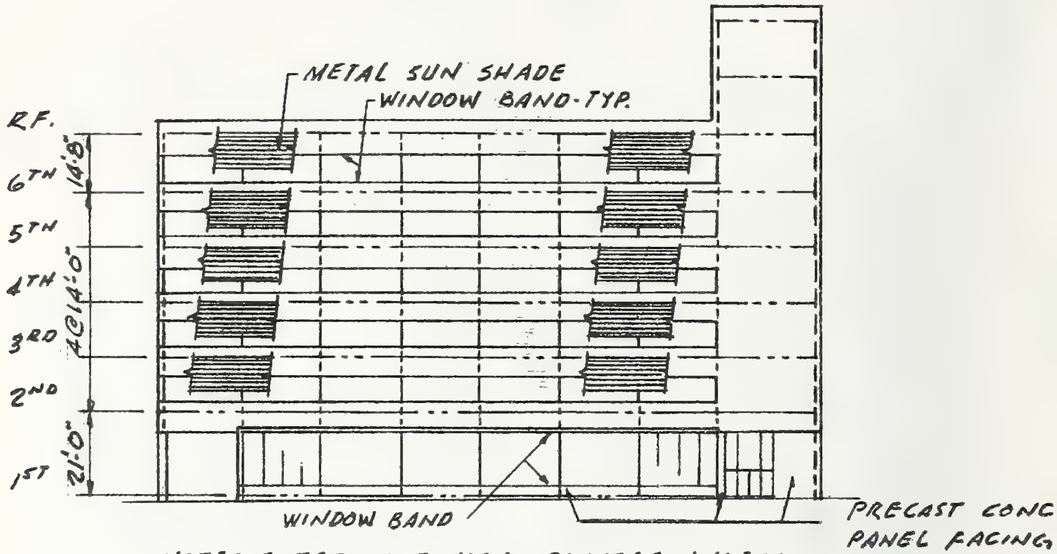
(Use additional sheet if necessary)



ELEVATION "A"

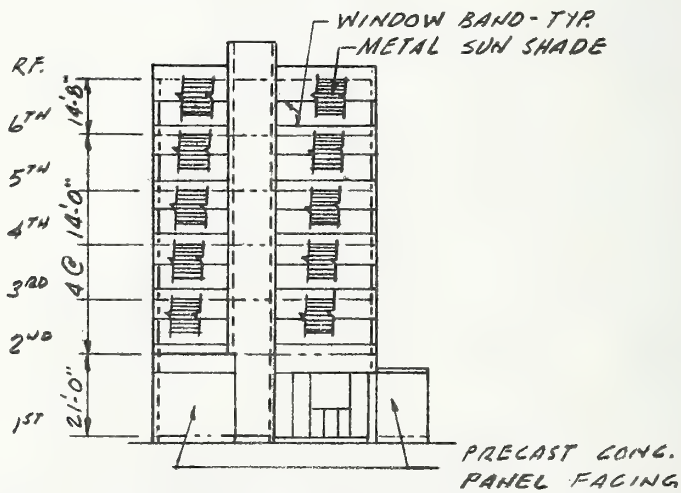


ELEVATION "B"



NOTE: EXTERIOR FINISH- PLASTER UNLESS OTHERWISE NOTED.

ELEVATION "C"



NOTE: EXTERIOR FINISH- PLASTER UNLESS OTHERWISE NOTED.

ELEVATION "D"

22. Elevation of Interior Shear Walls. NONE

Sketch:
a. All openings.
b. Major cracks or other damage. (Note if cracks are larger at one end.)
c. Note any previously repaired damage.

23. Adaptability of Basement to Storm Shelter.

a. Floor Over Basement - Concrete ☑ Other ☐

b. If concrete, give thickness 2½" CONC. OVER 1½" ST'L. DECK

c. Available Space (approximate) 10,500 sq. ft.

d. Dangerous Contents. Storage of Flammable Liquids ☐

Presence of Transformers or Other Dangerous Equipment ☑

Other Hazards ______________________

None ☐

24. Is this a Vault-like Structure? Yes ☐ No ☑

25. EXTERIOR WALL SUMMARY SHEET

Exterior Characteristics	Side A	Side B	Side C	Side D
Extensive Architectural Ornaments or Veneer	✓		✓	✓
WALLS Metal Curtain Wall				
Precast Concrete Curtain Wall				
Stone				
Brick				
Concrete Block				
Concrete				
Other	ST'L STUD & PLASTER	ST'L STUD & PLASTER	ST'L STUD & PLASTER	ST'L STUD & PLASTER
For Concrete Block and Brick, indicate R for Running Bond S for Stacked Bond				
Condition of Wall*	1	1	1	1
OPENINGS Percent of Open Area per Story 2 THRU 6	60%	0%	60%	60%
1ST	.06%	0%	60%	33%

*1. No cracks, good mortar.
2. Few visible cracks.
3. Many cracks
4. Evidence of minor repairs.
5. Evidence of many repairs.

B. SITE RELATED INFORMATION

1. Exposure

   a. Centers of large city [ ] b. Very rough hilly terrain [ ]

   c. Suburban areas, towns, city outskirts, wood areas, or rolling terrain [✓] d. Flat, open country [ ]

   e. Flat coastal belts [ ] f. Other [ ]

2. Topography

   a. Building on level ground [✓] b. Building on sloping ground [ ]

   c. Building located adjacent to embankment [ ]

*3. Geologic formation —

*4. Location of known faults: Name — Miles —

Miles ______

*5. Depth of water table — ft. When measured: — (Month) — (Year)

*6. Depth of bedrock — ft.

*7. Soil type —

*8. Bearing capacity — p.s.f., or — blows per inch

9. Proximity to potential wind-blown debris - Type LUMBER YARD LARGE

Location NORTH Distance 400'

*To be filled in by Field Supervisor.

C. STRUCTURAL SYSTEMS

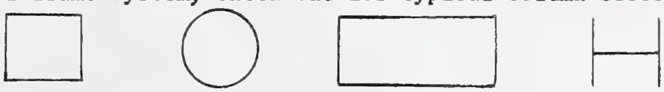
1. Material

Concrete ☐ Masonry ☐ Steel ☑ Wood ☐

2. Vertical Load Resisting System

Frame ☑ Bearing Wall ☐ Wall and Pilasters ☐

For frame system, check one for typical column cross-section



☐ ☐ ☐ ☑ Other ☐

3. Lateral Load Resisting System

Masonry Shear Wall ☐

Concrete Shear Wall ☐

Plywood Shear Wall ☐

Braced Frame ☐

Moment Resisting Frame ☑

Are resisting systems symmetrically located? ☑ Yes ☐ No

4. Floor System

Frame

Concrete Beams ☐

Steel Beams ☑

Steel Bar Joist ☐

Wood Beams ☐

No Framing Members ☐

Precast Concrete Beams ☐

Deck

Concrete Flat Plate ☐

Concrete Flat Slab ☐

Concrete Waffle Slab ☐

Steel Deck ☑ 2½" CONC TOPPING

Wood Joists ☐

Wood Plank ☐

Straight Sheathing ☐

Plywood Sheathing ☐

Diagonal Sheathing ☐

Precast Concrete Deck ☐

Concrete Joists ☐

Concrete Plank ☐

Note if concrete topping slab is used over metal decks or concrete plank.

Connection Details

	Framing	Decking To Framing
Bolted	[x]	[ ]
Welded	[ ]	[x]
Metal Clips	[ ]	[ ]
Wire Fastener	[ ]	[ ]
No Connection	[ ]	[ ]
Nailed	[ ]	[ ]
Metal Hangers	[ ]	[ ]

Anchorage Floor to Walls

Type PUDDLE WELDS STEEL DECK TO STEEL BEAMS

Spacing 3 PER DECK SHEET

5. Roof System

Frame

Concrete Beams	[ ]	Steel Truss	[x]
Steel Beams	[x]	Wood Truss	[ ]
Steel Bar Joist	[ ]	No Framing Members	[ ]
Wood Beams	[ ]	Precast Concrete Beams or Tees	[ ]
Wood Rafters	[ ]		

Deck

Concrete Flat Slab	[ ]	Concrete Waffle Slab	[ ]
Metal Decking	[x]	Plywood Sheathing	[ ]
Concrete Slab	[ ]	Diagonal Sheathing	[ ]
Concrete Joists	[ ]	Straight Sheathing	[ ]
Precast Decking	[ ]	Concrete Fill	Yes [x] No [ ]

Connection Details

	Framing	Decking to Framing
Bolted	✓	
Welded		✓
Metal Clips		
Wire Fastener		
No Connection		
Nailed		
Metal Hangers		

Anchorage Roof to Walls

Type PUDDLE WELDS STEEL DECK TO STEEL BEAMS

Spacing 3 PER DECK SHEET

D. NONSTRUCTURAL ELEMENTS

1. Partitions

Type

	Typical	Corridor
Partial Height		
Full Height Floor-To-Ceiling	✓	✓
Floor To Floor		
Movable		

Composition

Lath and Plaster	
Gypsum Wallboard	✓
Concrete Block	
Clay Tile	
Metal Partitions	

2. Ceiling

Typical Room

Material

Acoustical Tile [✓] Gypsum Board [ ] Plaster [ ]

Method of Attachment

Suspended [✓] Metal Channels [ ] Tee Bar Grid [ ]

Attached Directly to Structural Elements [ ]

Typical Corridor

Material

Acoustical Tile [✓] Gypsum Board [ ] Plaster [ ]

Method of Attachment

Suspended [✓] Metal Channels [ ] Tee Bar Grid [ ]

Attached Directly to Structural Elements [ ]

3. Light Fixtures

Typical Room

Recessed [✓] Surface Mounted [ ] Pendant (Suspended) [ ]

Typical Corridor

Recessed [✓] Surface Mounted [ ] Pendant (Suspended) [ ]

4. Mechanical Equipment

Location of Mechanical Equipment Room

Basement [✓] Other Floor [ ] Which Floor ______

Roof [✓]

Is Equipment Anchored to Floor? No [ ] Yes [✓]

Location of The Following Units

Liquid Storage Tank NONE

Cooling Tower ROOF

Air Conditioning Unit BASEMENT

5. Roofing

Description

Flat ☑ Arched ☐ Gabled ☐ If arched or gabled, sketch section.

Pitched ☐ Slope (1/8 :12)

Parapet No ☐ Yes ☑ Height (3 ft. 0 in.) Thickness (6 in.)

Material ST'L STUD & PLAS. Special Anchorage or Bracing Yes ☐ No ☑

Type

Built-up gravel ☑ Gravel ☐ Asphalt or Wood Shingles ☐

Clay Tile ☐ Other ☐

6. Windows

Type

Fixed ☑ Movable ☐

Frame Material:

Aluminum ☑ Steel ☐ Stainless Steel ☐ Wood ☐

Size: Average Size of Casing (5'-0" ft. x 6'-6" ft.)

Average Size of Glazing (5 ft. 0 in. x 6 ft. 6 in.)

How Casing is Attached to Structure

Bolted ☐ Screwed ☐ Clipped ☑ Welded ☐ Nailed ☐

Glazing Attachment to Casing

Elastomeric Gasket ☐ Glazing Bead ☑ Aluminum or Steel Retainer ☐

Other ☐

7. Gas Connection

Flexible Connection to Building ☑ Rigid Connection to Building ☐

Automatic Shut-off ☑ None ☐ Unknown ☐

INSPECTED BY ——

DATE ——

FIELD SUPERVISOR ——

C. Earthquake Evaluation

The building had been designed for earthquake using the UBC criteria in effect in 1957 for Zone 3. These criteria are different from UBC 1973. For this reason, new calculations have been made.

For the purpose of this example, the building is assumed to be located where it may be exposed to an earthquake of MMI 9.5. By entering this value into the formula ($2 \log 5Z_s = -1.973 + .375$ MMI) (see section 3.3B), the Z_s for the site is determined to be 1.25. This Z_s factor is used for Z in the UBC formula V = ZKCW (equation 14.1) for determining the base shear. The total base shear is distributed to each level in accordance with equation 14-4 and 14-5 of UBC. These equations are $F_t = .004V\left(\frac{h_n}{D_s}\right)^2$ and

$$F_x = \frac{(V - F_t)w_x h_x}{\sum_{i=1}^{n} w_i h_i}.$$

These symbols are defined in Section 2314(i).

Computations for this example have been limited to determining the proper horizontal forces and their distribution, critical elements and critical stress ratio. Overturning of the structure in the transverse direction has also been checked using the resistance to overturning by the vertical loads as determined in the original calculations.

The penthouse is two stories high, but small in plan. In accordance with the provisions in Section 2314(i) of the 1973 Uniform Building Code the penthouse is treated as a separate structure. Its horizontal reactions are applied to the roof of the main building.

Since this structure has a 100% moment-resistant frame, a K factor of 0.67 is used for the base shear computation.

The dead loads used for W were taken from the original calculations, after checking for reasonable compliance with the actual structure.

The horizontal loads in a N-S direction for Column Lines 3 and 4 are illustrated on calculation sheet 2-AM-E3. On Line 3 the frame columns bend about their strong axis and on Line 4 about their weak axis. The first story columns of Lines 3 and 4 were selected as the most critical members by reviewing the original calculations. These columns had the highest stress ratio $\left(\frac{\text{computed stress}}{\text{allowable stress}}\right)$.

The first story columns, because of their height, normally would be suspect in any case. Similarly, a check of the original calculations for the clear span steel trusses indicated that the stresses at the ends of the trusses from lateral force moments could be safely increased in the order of 25%. Therefore, these trusses were not considered to be the most critical elements.

The steel bents in this structure receive lateral forces in proportion to their relative rigidities. In this example some bents are more rigid than others, depending on the direction the columns are oriented. The original calculations computed the story-to-story deflections for a unit load. The reciprocal of this is a measure of the relative rigidity. After these relative rigidities are determined, the horizontal force at each level is distributed to the bents as shown on calculation sheet 2-AM-E-3. The method of distribution, in principle, is illustrated in detail in the example of a two-story structure in section 4.4.

The concrete and metal deck diaphragm used here is considered to be a rigid diaphragm. As such it will deliver torsional loads to the vertical elements. The center of mass and the center of rigidity for each level are computed. The eccentricity between these two centers produces torsional rotation. This results in forces to each bent being added or subtracted to the translational forces. This computation had been made on the original computations. Since for this example only the magnitude of lateral forces has been increased, the effects of torsion can be directly factored, which are shown on the diagram on calculation sheet 2-AM-E3. The method of computing the effect of torsion is illustrated in detail in the example of a two-story structure in section 4.4.

The code criteria upon which the original design was based, included a J factor which reduced the axial loads caused by overturning. This old equation was $J = \frac{0.6}{\sqrt[3]{T}}$ For this example, J was 0.72. The 1973 UBC criteria omits this J factor. Except for this, the bending moments and axial loads due to overturning could have been directly factored from the original calculations. This made it necessary to recompute the effect of overturning. This is shown on calculation sheet 2-AM-E3.

The first story column on Line 3 was first checked for combined axial and bending stresses and the stress ratio determined. These are shown on Sheets 2-AM-E4 and D-5. It is noted that the columns on Line 3 are oriented in the strong direction to resist north-south lateral forces. The combined stresses in the columns on Line 4 are checked on calculation sheet 2-AM-E6. These are oriented in the weak way for resisting north-south lateral forces. The stress ratio for Line 4 columns is higher than that for Line 3 columns. Thus, this becomes the critical stress ratio.

The adequacy of the diaphragm had been determined in the original calculations. Because of the comparatively short spans involved, the margin of safety was quite large and adequate even for these larger seismic forces. For this reason, no diaphragm calculations are included in this exampe.

Because of the light weight of the metal stud and plaster walls, the earthquake forces normal to the walls are very small. Wind would govern the design of these walls. Thus, no computations have been shown in this example for earthquake. In the original calculations the interior partitions were required to resist a 5 psf force normal to the walls. As the original calculations made showed these to be adequate, a stress ratio of <1.0 was given.

The metal sun shades are very light and therefore, wind governs the design of these elements and no earthquake computations are made. For this reason, the critical stress ratio for these elements for earthquake is listed as <1.0.

From the limited number of calculations necessary for this example, it is obvious that the availability of the original calculations saved a great deal of time in the analysis of this structure even though the earthquake forces are of a different magnitude and the overturning criteria changed.

DESIGN CRITERIA

LOAD CRITERIA (FROM ORIGINAL CALCULATIONS)

LOADS TO DETERMINE MASS OF BUILDING INCLUDES FLOOR, ROOF, EXTERIOR WALL AND PARTITION DEAD LOADS:

PENTHOUSE ROOF	=	101 p.s.f.
PENTHOUSE FLOOR	=	123
7^{TH} FLOOR	=	112
MAIN ROOF	=	80
2^{ND} TO 6^{TH} FLOORS	=	93
LOW ROOF	=	83

THE DEAD AND LIVE LOAD AXIAL LOADS AND MOMENTS IN COLUMNS ARE TAKEN FROM THE ORIGINAL CALCULATIONS.

EARTHQUAKE CRITERIA (CHAPTER 23 - 1973 U.B.C.)

$V = ZKCW$ (14-1)

$Z = Z_s = 1.25$

$K = 0.67$ 100% MOMENT RESISTANT FRAME BUILDING

$T = 0.10N = 0.1 \times 6$ STORIES $= 0.60$

$C = \frac{.05}{\sqrt[3]{T}} = \frac{.05}{\sqrt[3]{.60}} = .059$ - MAIN PORTION OF THE BUILDING

$C = 0.10$ MINIMUM FOR 2 STORY PENTHOUSE

SINCE $\frac{h_n}{D} = \frac{92'}{56'} = 1.16 < 3.0$, $F_t = 0$

STEEL DESIGN CRITERIA

ASTM A-7 STEEL, $F_y = 33$ k.s.i.

1969 AISC SPECIFICATIONS

MEMBERS TO BE CHECKED

FIRST STORY COLUMNS ON LINES 3 AND 4 WHICH HAVE THE HIGHEST STRESS RATIOS IN THE ORIGINAL CALCULATIONS WILL BE CHECKED.

SEISMIC ANALYSIS

BUILDING MASS, BASE SHEAR AND DISTRIBUTION OF SHEAR AT EACH LEVEL

LEVEL	AREA S.F.	D.L. K.S.F.	W_x K	h_x ft.	$W_x h_x$	$\frac{W_x h_x V}{\Sigma W_x h_x} = F_x$	V_x
PTHSE. ROOF	1350	.101	136	29.25	1053	6.5	6.5
PTHSE. FLOOR	1350	.123	166 / 302^K	18.25	3030 / 4083	18.8 / 25.3^K	25.3
	PENTHOUSE BASE SHEAR $V_{PH} = 1.25 \times .10 \times .67 \times 302 = 25.3^K$						
7^{TH} ROOF	1350 / 7760	.112 / .080	795	91.7	72,901	65.8	91.1
6^{TH}	9110	.093	847	77	65,219	58.9	150.0
5^{TH}	9110	.093	847	63	53,361	48.1	198.1
4^{TH}	9110	.093	847	49	41,503	37.5	235.6
3^{RD}	9110	.093	847	35	29,645	26.8	262.4
2^{ND} LOW ROOF	9110 / 1800	.093 / .083	996	21	20,916	18.9	281.3
1^{ST}							

$\Sigma W = 5179^K$ $\Sigma = 283{,}545$

$$\begin{array}{r} 256.0^K \\ \underline{25.3} \\ 281.3^K \end{array}$$

TOTAL BASE SHEAR

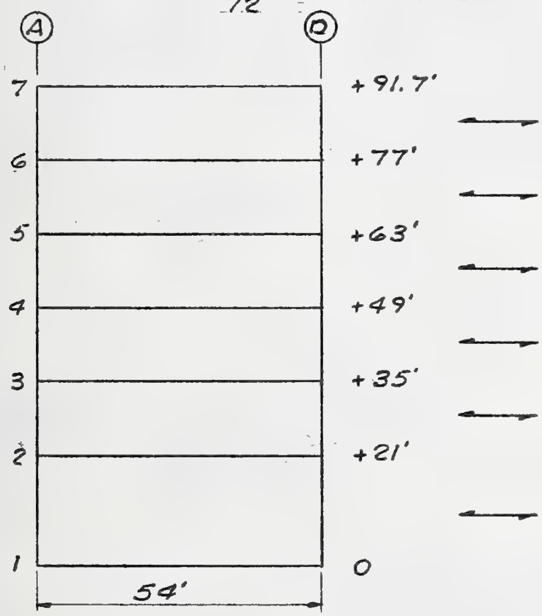
$V = Z K C W = 1.25 \times .67 \times .059 \times 5179 = 256^K + 25.3^K = 281.3^K$

RATIO OF SHEAR AT ROOF TO WEIGHTS OF ROOF AND ABOVE $\frac{91.1}{1097} = .083$, THEREFORE $C = 0.10$ FOR PENTHOUSE IS CORRECT.

SEISMIC ANALYSIS

DISTRIBUTION OF SHEARS TO FRAMES ON LINES 3 AND 4

TO DETERMINE THE SHEARS TO FRAMES 3 AND 4 DUE TO THE TRANSVERSE (N-S) SEISMIC LOADS, THE STORY SHEARS ARE DISTRIBUTED TO THE FRAMES IN PROPORTION TO THEIR RELATIVE STIFFNESSES. THE STORY SHEARS, INCLUDING THE EFFECTS OF TORSION, HAVE BEEN PRORATED USING THE RELATIVE STIFFNESSES OF THE FRAMES AS SHOWN IN THE ORIGINAL CALCULATIONS. FOR EXAMPLE ON LINE 3 AT 7^{TH} LEVEL; ORIGINAL SHEAR ON LINE 3 WAS 19.4^K, ORIGINAL STORY SHEAR WAS 72^K NEW STORY SHEAR = 91.1^K (SHEET 2-AM-E2) ∴ NEW LINE 3 SHEAR $= \frac{19.4}{72} \times 91.1 = 24.6^K$



STORY SHEARS LINE 3	STORY SHEARS LINE 4
24.6^K	11.8^K
36.8	17.7
46.8	22.5
54.8	26.3
60.1	28.8
65.0	31.2

OVERTURNING MOMENTS AND AXIAL LOADS ON COLUMNS

	OVERTURNING - LINE 3					OVERTURNING - LINE 4			
LEVEL	HEIGHT	STORY SHEAR K	O.T.M. 'K	ΣOTM 'K	AXIAL LOAD K	STORY SHEAR K	O.T.M. 'K	ΣOTM 'K	AXIAL LOAD K
7	14.7'	24.6	362	362	6.7	11.8	174	174	3.2
6	14.0'	36.8	515	877	16.2	17.7	247	421	7.8
5	14.0'	46.8	655	1532	28.4	22.5	314	735	13.6
4	14.0'	54.8	764	2296	42.5	26.3	368	1103	20.4
3	14.0'	60.1	841	3137	58.1	28.8	404	1507	27.9
2	21.0'	65.0	1363	4500	83.3	31.2	655	2162	40.0

SEISMIC ANALYSIS

1ST STORY COLUMNS ON LINE 3 FOR BENDING ABOUT MAJOR AND MINOR AXES

COLUMN W14 x 202
A-7 STEEL $F_y = 33$ K.S.I.

$A = 59.39^{\square''}$
$S_{xx} = 324.9''^3$ $\quad r_{xx} = 6.54''$
$S_{yy} = 124.4''^3$ $\quad r_{yy} = 4.06''$

COLUMN ALLOWABLE STRESS:

COLUMN LENGTH = 17' UNBRACED - BOTH DIRECTIONS
FROM 1969 AISC SPECIFICATIONS FIG. C1.8.2

$$\text{FOR } K\ell/r_x \quad G = \frac{\Sigma \frac{I_c}{L_c}}{\Sigma \frac{I_g}{L_g}} = \frac{\frac{2538}{17}}{\frac{40\,200}{54}} = .20 \qquad \text{FOR } K\ell/r_y \quad G = \frac{\frac{980}{17}}{\frac{40200}{20}} = .02$$

$K = 2.0$
X = AXIS

$K = 1.0$
Y = AXIS

$$K\ell/r_{xx} = \frac{2 \times 17 \times 12}{6.54} = 62.4 \qquad K\ell/r_{yy} = \frac{1 \times 17 \times 12}{4.06} = 50.2$$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = 131.6$$

$$F_a = \frac{\left[1 - \frac{(K\ell/r)^2}{2C_c^2}\right] F_y}{5/3 + \frac{3(K\ell/r)}{8C_c} - \frac{(K\ell/r)^3}{8C_c^3}} = \frac{\left[1 - \frac{(62.4)^2}{2 \times 131.6^2}\right] \times 33}{5/3 + \frac{3 \times 62.4}{8 \times 131} - \frac{(62.4)^3}{8 \times 131.6^3}} = \frac{29.29}{1.67 + .178 - .01}$$

$F_a = 15.96$ K.S.I.

$$F'_{ex} = \frac{12\pi^2 E}{23\left(K\frac{\ell_b}{r_b}\right)^2} = \frac{12 \times \pi^2 \times 29 \times 10^6}{23 \times 62.4^2} = 38.31 \text{ K.S.I.}$$

$$F'_{ey} = \frac{12\pi^2 E}{23 \times 50.2^2} = 59.2 \text{ K.S.I.}$$

$F_b = .66 F_y = .66 \times 33 = 21.8$ K.S.I.

$$\frac{b_f}{2t_f} < \frac{52.2}{\sqrt{F_y}} \quad \therefore F_{by} = .75 F_y = .75 \times 33 = 24.75 \text{ K.S.I.}$$

SEISMIC ANALYSIS

1ST STORY COLUMNS ON LINE 3 FOR BENDING ABOUT MAJOR AXIS

LOADS ON COLUMNS - LINE 3 - 1ST STORY:

AXIAL: DEAD PLUS LIVE = 413^K - FROM ORIGINAL CALCULATIONS
N-S OVERTURNING = 83.3^K

BENDING MOMENTS:

DEAD PLUS LIVE = $49'^K$ - FROM ORIGINAL CALCULATIONS
N-S SEISMIC = $275'^K$ - PRORATED FROM ORIGINAL CALCULATIONS
E-W BENDING = $6.3'^K$ DUE TO TORSION OF N-S SEISMIC

STRESS RATIOS FOR AXIAL AND BENDING
(SEE SHEET 2-AM-E4 FOR ALLOWABLE STRESSES) (AISC 16-1a)

GRAVITY LOADS:

$$\frac{f_a}{F_a} = \frac{413/59.4}{15.96} = \frac{6.95}{15.96} \qquad = .436$$

$$\frac{C_{mx} f_{bx}}{\left(1-\frac{f_a}{F'_{ex}}\right)F_{bx}} = \frac{.85\,(49\times 12)/325}{\left(1-\frac{6.95}{38.31}\right)21.8} = \frac{1.53}{17.85} = \underline{.086}$$

$$\Sigma = .522$$

SEISMIC LOADS

$$\frac{f_a}{F_a} = \frac{83.3/59.4}{15.96} = \frac{1.40}{15.96} \qquad = .088$$

$$\frac{C_{mx} f_{bx}}{\left(1-\frac{f_a}{F'_{ex}}\right)F_{bx}} = \frac{.85\times(275\times 12)/325}{\left(1-\frac{8.35}{38.31}\right)21.8} = \frac{8.63}{17.05} = .506$$

$$\frac{C_{my} f_{by}}{\left(1-\frac{f_a}{F'_{ey}}\right)F_{by}} = \frac{.85\times(6.3\times 12)/24.4}{\left(1-\frac{8.35}{59.2}\right)24.75} = \frac{.516}{21.26} = \underline{.024}$$

$$\Sigma = .619$$

$$\text{STRESS RATIO} = \frac{.619}{1.33-.522} = .766 \text{ O.K.}$$

SEISMIC ANALYSIS

1ST STORY COLUMNS ON LINE 4 FOR BENDING ABOUT MINOR AXIS

LOADS ON COLUMNS - LINE 4 - 1ST STORY

AXIAL: DEAD PLUS LIVE = 413^K - FROM ORIGINAL CALCULATIONS
N-S OVERTURNING = 40.0^K

BENDING MOMENTS:

DEAD PLUS LIVE = $26^{'K}$ - FROM ORIGINAL CALCULATIONS
N-S SEISMIC = $208^{'K}$ - PRORATED FROM ORIGINAL CALCULATIONS
E-W BENDING = $4.8^{'K}$ - DUE TO TORSION OF N-S SEISMIC

STRESS RATIOS FOR AXIAL AND BENDING
(SEE SHEET 2-AM-G4 FOR ALLOWABLE STRESSES)(AISC 1.6-1a)

GRAVITY LOADS:

$$\frac{f_a}{F_a} = \frac{413/59.4}{15.96} = \frac{6.95}{15.96} = .436$$

$$\frac{C_{mx} f_{by}}{\left(1-\frac{f_a}{F'_{ey}}\right)F_{by}} = \frac{.85\times(26\times12)/124.4}{\left(1-\frac{6.95}{59.2}\right)24.75} = \frac{2.13}{21.84} = \underline{.098}$$

$$\Sigma = .534$$

SEISMIC LOADS:

$$\frac{f_a}{F_a} = \frac{40.0/59.4}{15.96} = \frac{.68}{15.96} = .042$$

$$\frac{C_{mx} f_{by}}{\left(1-\frac{f_a}{F'_{ey}}\right)F_{by}} = \frac{.85\times(208\times12)/124.4}{\left(1-\frac{7.63}{59.2}\right)24.75} = \frac{17.05}{21.36} = .791$$

$$\frac{C_{my} f_{by}}{\left(1-\frac{f_a}{F'_{ex}}\right)F_{bx}} = \frac{.85\times(4.8\times12)/325}{\left(1-\frac{7.63}{38.31}\right)21.8} = \frac{.14}{17.36} = \underline{.008}$$

$$\Sigma = .841$$

$$\text{STRESS RATIO} = \frac{.841}{1.33-.534} = 1.056$$

THIS IS CRITICAL STRESS RATIO FOR COLUMNS. ENTER IN 2-FORM-AMA-1.

FACILITY NO. EXAMPLE 2 FORM AMA-1

APPROXIMATE ANALYTICAL METHOD
STRUCTURAL SYSTEMS - EARTHQUAKE RATING

BUILDING DESIGNATION:							
Type of Frame	Type of Diaphragm	Modified Mercalli Intensity	Z_s	Z_c	Critical Elements		Critical Stress Ratio (f_e/f_a)
					Type	Location	
A	2½" CONC. FILL ON 1½" STEEL DECK	9.5	1.25	1.0	COL.	1ST STORY	1.06

TYPE

A Steel Moment Resistant Frames
B Steel Frames - Vertical Load Carrying Only
C Concrete Moment Resistant Frames
D Concrete Frames - Vertical Load Carrying Only
E Masonry Shear Walls - Unreinforced
F Masonry or Concrete Shear Walls - Reinforced
G Combination - Unreinforced Shear Walls and Moments Resistant Frames
H Combination - Reinforced Shear Walls and Moment Resistant Frames
J Braced Frames
K Wood Frame Buildings, Walls Sheathed or Plastered
L Wood Frame Buildings, Walls Without Wood Sheathing or Plaster
M Other

Z_s = Zone factor determined for site from Modified Mercalli Intensity.

Z_c = Zone factor from Code.

NOTE: For rating of Structural Systems, use Form AME.

FACILITY NO. EXAMPLE 2

APPROXIMATE ANALYTICAL METHOD
EXIT CORRIDOR AND STAIR ENCLOSURE WALLS - EARTHQUAKE RATING

Type of Wall	Reinforcement		Anchorage				Critical Stress Ratio f_e/f_a	Rating*
	Present	Not Present	Mortar Only	Dowels	Screws or Bolts	Other		
Brick		X						
Brick		X						
Concrete Block		X						
Concrete Block		X						
Reinforced Concrete		X						
Tilt-up or Precast Concrete		X						
Steel Studs & Plaster	X					WELDS	< 1.0	GOOD
Wood Studs & Plaster		X						
Hollow Tile		X						
Hollow Tile & Plaster		X						
		X						

*Obtained from Form AME - Rating of Critical Stress Ratios.

FORM AMB-1

FACILITY NO. EXAMPLE 2 FORM AMB-2

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - EARTHQUAKE RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING*
Partitions Other Than on Corridors or Stair Enclosures	< 1.0	GOOD
Exterior Appendages and Wall Cladding	< 1.0	GOOD
Ceiling	NOT BRACED	POOR
Light Fixtures	RECESSED INTO UNBRACED CEILING	POOR

*See Form AME - Rating of Critical Stress Ratios.

D. Wind Evaluation

It is assumed that the structure is located where it will be subjected to a basic wind speed of 90 miles per hour, Exposure "B." This gives a larger wind force on the building than was used in the original calculations.

The computations for this example have been carried only so far as to determine the forces on the building as a whole and determine the critical element and the critical stress ratio. The lateral force distributions have been pro-rated from the original calculations. The contributions of vertical loads are those in the original calculations.

The wind forces q_F are taken from table 5, Exposure B, ANSI 1972 for a Basic Wind Speed of 90 miles per hour for the various height levels of the building. These are shown in the tables on calculation sheet 2-AM-3 where the forces are given for each level. The q_F values are multiplied by 1.3 to be in accordance with table 7 of ANSI for the effect of both windward and leeward pressures on the building as a whole. This is done for both north-south and east-west directions. Because of the greater exposure to north-south winds, this wind direction is the most critical.

The relative stiffness of bents, centers of rigidity and wind forces had originally been computed for lesser wind forces and for a different vertical distribution. However, the center of wind loads at each level was nearly the same and the small differences in eccentricity were considered negligible. Therefore, that portion of the wind load at any level going to any bent could be obtained by a direct ratio of loads. The diaphragm was considered to be rigid for distribution of lateral forces.

The original calculations were checked to find which elements had the highest stress ratios (design stresses/allowable) under combined vertical and lateral loads. Since the vertical loads are the same as for the original calculations, variations in the lateral forces alone will vary the stress ratios but not in direct proportion. However, these stress ratios from the original design calculations serve as a very good clue.

The highest stress ratios in the original calculations occurred in the first story columns in Lines 3 and 4. There was considerable margin of safety in the horizontal trusses and their end connections so these were not investigated. A check was made, however, on the fourth story column on Line 3 which in the original calculations had the highest stress ratio in the upper stories.

The stress ratio for the new wind load criteria was found to be highest for the first story columns on Line 4 and these are the critical elements for the building as a whole.

The adequacy of the exterior steel stud and plaster walls was checked at the penthouse where the wind load was the highest and the vertical span of the studs the greatest. This computation is shown on calculation sheet 2-AM-W9.

Computations for uplift on the roof were not made because the uplift forces are less than the dead load, as indicated in the original calculations.

The precast concrete panels are attached to the steel frame in such a manner as to permit lateral sway of the frame. For normal loads, the panels are attached to the lower flanges of the spandrel beams with clip angles and 5/8"Ø bolts at 3 ft centers. These connections were designed for a 15 psf wind which at this first story level is greater than the wind force the structure is being checked for. For this reason, the stress ratio given is simply <1.0.

The exterior architectural fins or screens are anchored by complicated steel details to the main frame. Since the upper stories of this building were designed for a 20 psf wind pressure which is approximately the same criteria for which the building is being checked, no additional calculations are made and the stress ratio for "Anchorage of Exterior Appendages" is noted as <1.0.

DESIGN CRITERIA

LOAD CRITERIA (FROM ORIGINAL CALCULATIONS)

DEAD LOADS:

PENTHOUSE ROOF	= 91 p.s.f	
PENTHOUSE FLOOR	= 103 "	INCLUDING MECHANICAL
7TH FLOOR	= 102 "	
MAIN ROOF	= 75 "	
2ND TO 6TH FLOORS	= 73 "	
LOW ROOF	= 75 "	

LIVE LOADS:

ROOFS	= 20 p.s.f.
FLOORS	= 50 "

THE DEAD AND LIVE LOAD AXIAL LOADS AND MOMENTS IN COLUMNS ARE TAKEN FROM THE ORIGINAL CALCULATIONS.

WIND CRITERIA (ANSI A58.1 - 1972)

BASIC WIND SPEED = 90 m.p.h. EXPOSURE 'B'
EFFECTIVE VELOCITY PRESSURE AT 30ft. ELEVATION
q_F = 16 p.s.f. (TABLE 5)

EXTERNAL PRESSURE COEFFICIENTS FOR WALLS, C_p

WINDWARD WALL	= 0.8
LEEWARD WALL	= 0.5
TOTAL DESIGN WIND	= 1.3

UPLIFT PRESSURE COEFFICIENTS ON ROOF = -0.7 (SECT. 6.5.3.2.1)

LOCAL PRESSURE ON WALLS AT CORNERS = -2.0 (SECT. 6.5.3.1)

STEEL DESIGN CRITERIA

STRUCTURAL STEEL - ASTM A-7, Fy = 33 k.s.i., 1969 AISC SPECIFICATIONS

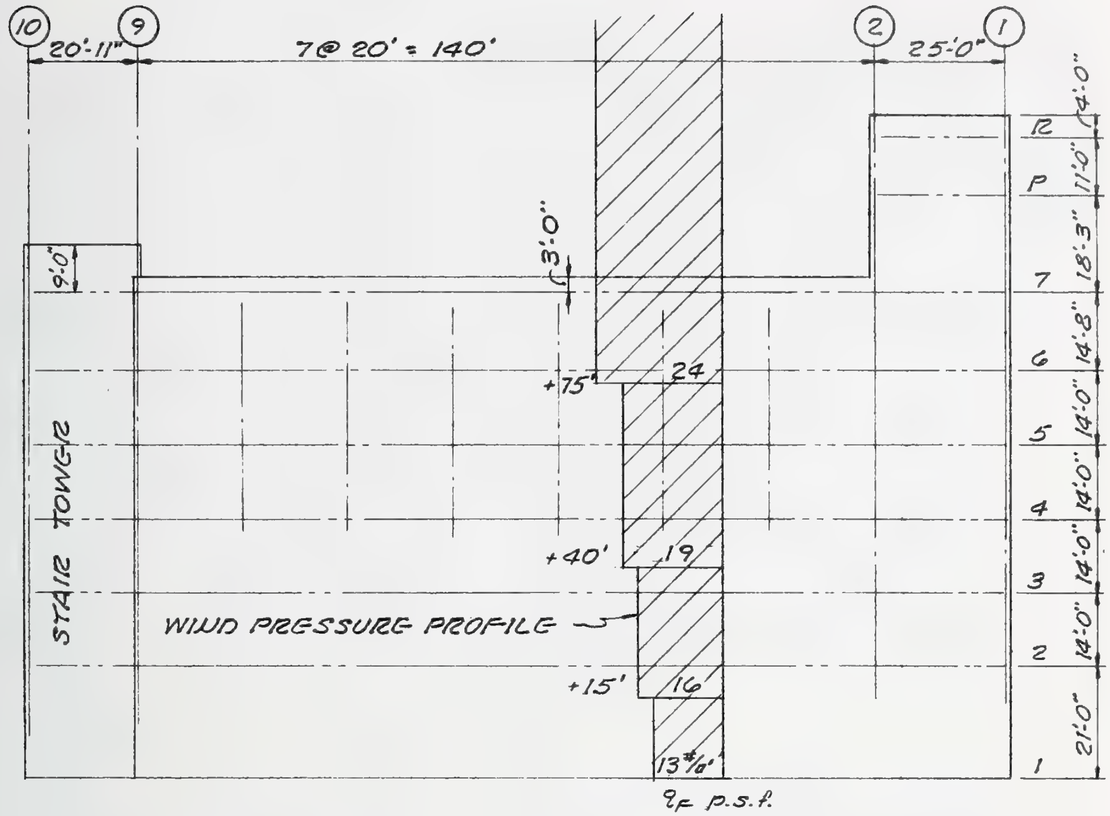
STEEL STUDS - AISI SPECIFICATIONS FOR THE DESIGN OF COLD FORMED STEEL STRUCTURAL MEMBERS - 1968 ED.

MEMBERS TO BE CHECKED

FIRST AND FOURTH STORY COLUMNS ON LINES 3 AND 4 WHICH HAVE THE HIGHEST STRESS RATIOS IN THE ORIGINAL CALCULATIONS WILL BE CHECKED.

WIND ANALYSIS

WIND PRESSURE DISTRIBUTION



NORTH ELEVATION

HATCHED AREA SHOWS VARIATIONS IN PRESSURE ON THE PROFILE

USING STEP FUNCTION METHOD - PRESSURE CHANGE AT +15', +40' & +75'

EXTERNAL PRESSURE COEFFICIENTS:

$$\frac{\text{HEIGHT}}{\text{WIDTH}} = \frac{121}{54} = 2.24$$

LESS THAN 2.5 ∴ COEFFICIENT ON LEEWARD WALL = 0.5
COEFFICIENT ON WINDWARD WALL = 0.8

$1.3\,q_F$ = PRESSURE ON BUILDING

WIND ANALYSIS

WIND FORCES AND SHEARS AT EACH LEVEL

N-S WIND

LEVEL	HEIGHT	q_F p.s.f.	TRIB. HEIGHT	LENGTH	WIND FORCE $1.3 q_F A$	STORY SHEAR
R	121	24	9.5	27	8,003	8.0^K
P	110	24	14.65	27	12,341	20.3
7	91.7	24 24 24	16.5 10.35 16.35	27 140 22	13,900 45,280 11,222	90.7
6	77	24 19	9.35 5.0	188 188	54,843 23,218	168.8
5	68	19	14.0	188	65,010	233.8
4	49	19	14.0	188	65,010	298.8
3	35	19 16	2.0 12.0	188 188	9,287 46,925	355.0
2	21	16 13	13.0 4.5	188 188	50,835 14,297	420.1

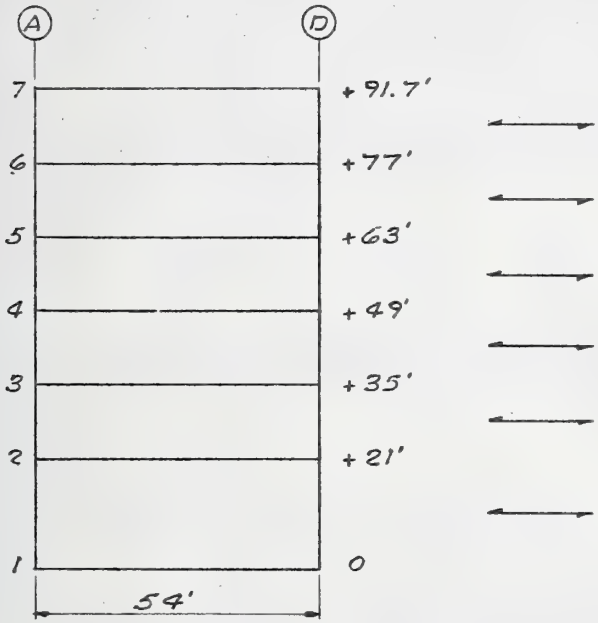
E-W WIND

R	121	24	9.5	56.5	16,747	16.7^K
P	110	24	14.65	56.5	25,825	42.6
7	91.7	24	16.5	56.5	29,086	71.7
6	77	24 19	9.35 5.0	56.5 56.5	16,482 6,978	95.1
5	63	19	14.0	56.5	19,538	114.7
4	49	19	14.0	56.5	19,538	134.2
3	35	19 16	2.0 12.0	56.5 56.5	2,791 14,102	151.1
2	21	16 13	13.0 4.5	56.5 56.5	15,278 4,297	170.7

WIND ANALYSIS

DISTRIBUTION OF SHEARS TO FRAMES ON LINES 3 AND 4

TO DETERMINE THE SHEARS TO FRAMES 3 AND 4 DUE TO THE TRANSVERSE (N-S) WIND LOADS, THE STORY SHEARS ARE DISTRIBUTED TO THE FRAMES IN PROPORTION TO THEIR RELATIVE STIFFNESSES. THE STORY SHEARS, INCLUDING THE EFFECTS OF TORSION, HAVE BEEN PRORATED USING THE RELATIVE STIFFNESSES OF THE FRAMES AS SHOWN IN THE ORIGINAL CALCULATIONS. FOR EXAMPLE ON LINE 3 AT 7TH LEVEL; ORIGINAL SHEAR ON LINE 3 WAS 11.35^K ORIGINAL STORY SHEAR WAS 42^K NEW STORY SHEAR = 90.7^K (SHEET 2-AM-W3) ∴ NEW LINE 3 SHEAR = $\frac{11.35}{42} \times 90.7 = 24.5^K$



STORY SHEARS LINE 3	STORY SHEARS LINE 4
24.5^K	11.7
40.7	19.4
54.2	25.8
67.8	32.3
79.3	37.8
96.0	45.8

OVERTURNING MOMENTS AND AXIAL LOADS ON COLUMNS

		OVERTURNING - LINE 3				OVERTURNING - LINE 4			
LEVEL	HEIGHT	STORY SHEAR K	OTM 'K	ΣOTM 'K	AXIAL LOAD K	STORY SHEAR K	OTM 'K	ΣOTM 'K	AXIAL LOAD K
7	14.7'	24.5	360	360	6.7^K	11.7	172	172	3.2^K
6	14.0'	40.7	570	930	17.2	19.4	272	444	8.2
5	14.0'	54.2	759	1689	31.3	25.8	361	805	14.9
4	14.0'	67.8	949	2638	48.9	32.3	452	1257	23.3
3	14.0'	79.3	1110	3748	69.4	37.8	529	1786	33.1
2	21.0'	96.0	2016	5764	106.7	45.8	962	2748	50.9

WIND ANALYSIS

1ST STORY COLUMNS ON LINE 3 FOR BEND ABOUT MAJOR AXIS

LOADS ON COLUMNS - LINE 3 - 1ST STORY:

AXIAL: DEAD PLUS LIVE = 413^K - FROM ORIGINAL CALCULATIONS
N-S OVERTURNING = 106.7^K

BENDING MOMENTS:

DEAD PLUS LIVE = 49$^{'K}$ - FROM ORIGINAL CALCULATIONS
N-S WIND = 406$^{'K}$ - PRORATED FROM ORIGINAL CALCULATIONS
E-W BENDING = 5.9$^{'K}$ - DUE TO TORSION OF N-S WIND

STRESS RATIOS FOR AXIAL AND BENDING

(SEE SHEET 2-AM-E4 FOR ALLOWABLE STRESSES)(AISC 1.6-1a)

GRAVITY LOADS:

$$\frac{f_a}{F_a} = \frac{413/59.4}{15.96} = \frac{6.95}{15.96} = .436$$

$$\frac{C_{mx} f_{bx}}{\left(1-\frac{f_a}{F'_{ex}}\right)F_{bx}} = \frac{.85(49\times 12)/325}{\left(1-\frac{6.95}{38.31}\right)21.8} = \frac{1.53}{17.85} = .086$$

$$\Sigma = .522$$

WIND LOADS:

$$\frac{f_a}{F_a} = \frac{106.7/59.4}{15.96} = \frac{1.80}{15.96} = .112$$

$$\frac{C_{mx} f_{bx}}{\left(1-\frac{f_a}{F'_{ex}}\right)F_{bx}} = \frac{.85\times(406\times 12)/325}{\left(1-\frac{8.75}{38.31}\right)21.8} = \frac{12.74}{16.82} = .757$$

$$\frac{C_{my} f_{by}}{\left(1-\frac{f_a}{F'_{ey}}\right)F_{by}} = \frac{.85(5.9\times 12)/124.4}{\left(1-\frac{8.75}{59.2}\right)24.75} = \frac{.48}{21.09} = .023$$

$$\Sigma = .892$$

$$\left(\frac{f_w}{f_a}\right) \text{STRESS RATIO} = \frac{.892}{1.33-.522} = 1.10 > 1.0 \text{ CRITICAL}$$

WIND ANALYSIS

1ST STORY COLUMNS ON LINE 4 FOR BENDING ABOUT MINOR AXIS

LOADS ON COLUMNS - LINE 4 - 1ST STORY

AXIAL : DEAD PLUS LIVE = 413^K - FROM ORIGINAL CALCULATIONS
N-S OVERTURNING = 50.9^K

BENDING MOMENTS:

DEAD PLUS LIVE = $26'^K$ - FROM ORIGINAL CALCULATIONS
N-S WIND = $194'^K$ - PRORATED FROM ORIGINAL CALCULATONS
E-W BENDING = $4.4'^K$ - DUE TO TORSION OF N-S WIND

STRESS RATIOS FOR AXIAL AND BENDING
(SEE SHEET 2-AM-E4 FOR ALLOWABLE STESSES)(AISC 16-1a)

GRAVITY LOADS:

$$\frac{f_a}{F_a} = \frac{413/59.4}{15.96} = \frac{6.95}{15.96} = .436$$

$$\frac{C_{mx} f_{by}}{\left(1-\frac{f_a}{F'_{ey}}\right) F_{by}} = \frac{.85\,(26 \times 12)/124.4}{\left(1-\frac{6.95}{59.2}\right) 24.75} = \frac{2.13}{21.84} = \underline{.098}$$

$$\Sigma = .534$$

WIND LOADS:

$$\frac{f_a}{F_a} = \frac{50.9/59.4}{15.96} = \frac{.86}{15.96} = .054$$

$$\frac{C_{my} f_{by}}{\left(1-\frac{f_a}{F'_{ey}}\right) F_{by}} = \frac{.85 \times (194 \times 12)/124.4}{\left(1-\frac{7.81}{59.2}\right) 24.75} = \frac{15.91}{21.48} = .741$$

$$\frac{C_{mx} f_{bx}}{\left(1-\frac{f_a}{F'_{ex}}\right) F_{bx}} = \frac{.85\,(4.4 \times 12)\,325}{\left(1-\frac{7.81}{38.31}\right) 21.8} = \frac{.14}{17.36} = \underline{.008}$$

$$\Sigma = .749$$

$$\frac{f_w}{f_a} = \text{STRESS RATIO} = \frac{.749}{1.33 - .534} = .94 < 1.0$$

WIND ANALYSIS

4TH STORY COLUMNS ON LINE 3 FOR BENDING ABOUT MAJOR AND MINOR AXES

COLUMN W14 x 150
A-7 STEEL $F_y = 33$ K.S.I.

$A = 44.1^{\square''}$
$S_{xx} = 240''^3$ $\quad r_{xx} = 6.37''$
$S_{yy} = 90.6''^3$ $\quad r_{yy} = 3.99''$

COLUMN ALLOWABLE STRESS:

COLUMN LENGTH = 10' UNBRACED - BOTH DIRECTIONS
FROM 1969 AISC SPECIFICATIONS FIG. C1.8.2

$$\text{FOR } K\ell/r_x \quad G = \frac{\frac{2540}{10}}{\frac{40200}{54}} = .12 \qquad K = 1.0 \text{ EACH WAY}$$

$$K\ell/r_x = \frac{1 \times 10 \times 12}{6.37} = 19 \qquad K\ell/r_y = \frac{1 \times 10 \times 12}{3.99} = 30$$

$$C_c = \sqrt{\frac{2\pi^2 E}{33}} = 131.6$$

$$F_a = \frac{\left[1 - \frac{30.0^2}{2 \times 131.6^2}\right] \times 33}{5/3 + \frac{3 \times 30}{8 \times 131.6} - \frac{30^3}{8 \times 136.6^3}} = \frac{29.57}{1.67 + .085 - .001} = 16.86 \text{ K.S.I.}$$

AISC 1.5.1.3.1

$$F'_{ex} = \frac{12\pi^2 E}{23\left(\frac{K\ell b}{rb}\right)^2} = \frac{12 \times \pi^2 \times 29 \times 10^6}{23 \times 19^2} = 400$$

$$F'_{ey} = \frac{12\pi^2 \times 29 \times 10^6}{23\,(30)^2} = 165.9$$

$$F_{bx} = .66 F_y = .66 \times 33 = 21.8 \text{ K.S.I}$$

$$\text{FOR } F_{by} - \frac{b_f}{2t_f} < \frac{52.2}{\sqrt{F_y}} \quad \therefore F_{by} = .75 F_y = .75 F_y = .75 \times 33 = 24.75 \text{ K.S.I.}$$

WIND ANALYSIS

4TH STORY COLUMNS ON LINE 3 FOR BENDING ABOUT MAJOR AXIS

LOADS ON COLUMNS - LINE 3 - 4TH STORY:

AXIAL: DEAD PLUS LIVE = 235^K - FROM ORIGINAL CALCULATIONS
N-S OVERTURNING = 31.3^K

BENDING:

DEAD PLUS LIVE = $87^{\prime K}$ - FROM ORIGINAL CALCULATIONS
N-S WIND = 135.4 - PRORATED FROM ORIGINAL CALCULATIONS
E-W BENDING = 3.8 - DUE TO TORSION OF N-S WIND

STRESS RATIOS FOR AXIAL AND BENDING
(SEE SHEET 2-AM-W7 FOR ALLOWABLE STRESSES) (AISC 1.6-1a)

GRAVITY LOADS:

$$\frac{f_a}{F_a} = \frac{235/44.1}{16.86} = \frac{5.33}{16.86} = .316$$

$$\frac{C_{mx} f_{bx}}{\left(1-\frac{f_a}{F'_{ex}}\right)F_{bx}} = \frac{.85(87\times12)/240}{\left(1-\frac{5.33}{400}\right)21.8} = \frac{3.7}{21.5} = \underline{.172}$$

$\Sigma = .488$

WIND LOADS:

$$\frac{f_a}{F_a} = \frac{31.3/44.1}{16.86} = \frac{.709}{16.86} = .042$$

$$\frac{C_{mx} f_{bx}}{\left(1-\frac{f_a}{F'_{ex}}\right)F_{bx}} = \frac{.85(145.8\times12)/240}{\left(1-\frac{6.04}{400}\right)21.8} = \frac{6.2}{21.5} = .288$$

$$\frac{C_{mx} f_{by}}{\left(1-\frac{f_a}{F'_{ey}}\right)F_{by}} = \frac{.85(3.8\times12)/90.6}{\left(1-\frac{6.04}{165.9}\right)24.75} = \frac{.48}{23.85} = \underline{.020}$$

$\Sigma = .350$

$$\text{STRESS RATIO} = \frac{.350}{1.33-.488} = .416$$

WIND ANALYSIS

EXTERIOR WALL STUDS FOR WIND FLEXURE

MAXIMUM HEIGHT OF STUDS AT PENTHOUSE FLOOR TO PENTHOUSE ROOF = 18'-3"

WIND FORCE. FROM ANSI A58.1-1972 - PRESSURE COEFFICIENT, = C_p = -2.0 AT CORNERS.
FROM TABLE 6 - EPOSURE B, 90 m.p.h. WIND, q_p = 27 p.s.f. OVER 50' ABOVE GRADE.

THEREFORE $P = q_p C_p = 27 \times -2.0 = -54$ p.s.f.

STUDS - 6" - 16" GAGE WITH 1¼" FLANGES AT 16" ON CENTER, F_y = 50 K.S.I, w = 1.0972", t = .0598", S_{xx} = .745"^{3} FROM MANUFACTURES CATALOGE.

STUD ALLOWABLE STRESSES:

IN AISI - SECTION 3.2 (b) $w/t = \dfrac{1.0972}{.0598} = 18.37$

$\dfrac{63.3}{\sqrt{F_y}} = 8.95 < 18.37$ $\qquad$ $\dfrac{144}{\sqrt{F_y}} = 20.36 > 18.37$

$$F_c = F_y \left[0.767 - (2.64/10^3)\ w/t \sqrt{F_y}\right]$$

$$F_c = 50 \left[0.767 - \frac{2.64}{10^3} \times 18.37 \times \sqrt{50}\right] = 21,225 \text{ p.s.i.}$$

ALLOWABLE FLEXURAL STRESS = 21,225 × 1.33 = 28,230 p.s.i.

BENDING MOMENT DUE TO WIND PRESSURE P:

$$M = \frac{18.25^2}{8} \times 1.33\,(-54) = 2990 \text{ ft.-lbs}$$

$$\text{BENDING STRESS} = \frac{2990 \times 12}{.745} = 48,162 \text{ p.s.i.}$$

$$\text{STRESS RATIO} = \frac{48,162}{28,230} = 1.71 \quad \text{CRITICAL}$$

FACILITY NO. *EXAMPLE 2*

APPROXIMATE ANALYTICAL METHOD
STRUCTURAL SYSTEMS - WIND RATING

BUILDING DESIGNATION:

Exposure A,B,or C	Basic Wind Speed* V_1	Building Height	Effective Velocity Pressure q_F	Design Unit Pressure q_Fx1.4=P or q_Fx1.3=P	Critical Elements		Critical Stress Ratio f_w/f_a	Basic Wind Speed Capacity $V_2 = V_1\sqrt{f_a/f_w}$
					Type	Location		
B	90	92' ±	13 TO 24	17 TO 31	COL.	1ST STORY	1.10	86

*See ANSI A58.1-72

f_w = Stress resulting from design pressures.
f_a = Allowable Material stress (x 1.33 where applicable)

NOTE: For rating of Structural Systems, use Form AME.

FORM AMC-1

FACILITY NO. EXAMPLE 2 FORM AMC-2

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - WIND RATING

TYPE OF RISK	CRITICAL STRESS RATIO	RATING
Glass Breakage*	------	COMPLIANCE
Glazing*	------	COMPLIANCE
Window Frame Anchorage	<1.0	GOOD
Wall Cladding Anchorage	<1.0	GOOD
Anchorage of Exterior Appendages	<1.0	GOOD
Exposed Walls	1.71	POOR
Canopies and Eaves	NONE	

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE*

TYPE	QUANTITY	DISTANCE
NONE		

*See Instructions for ratings.

CRITICAL STRESS RATIO	RATING
< 1.0	Good
1.0 to 1.5	Fair
> 1.5	Poor

E. <u>Tornado Evaluation</u>

The design forces for tornado for this example are direct horizontal wind pressures of 80 psf on the windward side and 50 psf on the leeward side. The uplift pressure on the roof and horizontal surfaces is 172 psf. The basis of this criteria for moderate resistance to tornadoes is explained in section 3.3D.

This building has a moment-resisting steel frame available to resist lateral forces. Calculations were available for earthquake and for a lesser wind pressure. Calculations are made for the tornado forces at each level. Original calculations show a distribution of horizontal forces to the individual bents based on relative rigidities. This same distribution (percentage of total load to a bent) is used for tornado forces.

The critical members as determined from the original wind computations were the first story columns on Line 4. This bent has columns oriented the weak way in resisting north-south lateral forces. A load diagram is shown for this bent and the corresponding bending moments in the columns are computed. The axial loads for overturning are also computed and the vertical loads are taken from the original calculations. These have been checked and found to be reasonably accurate. The columns are checked for combined stresses and the stress ratio computed. The allowable stresses are based on plastic design criteria.

The uplift on the roof could be critical since this exceeds the dead load. The roof trusses are braced only at mid-point and the capacity of the lower chords to take compression checked. One intermediate penthouse roof beam is also checked for uplift. For uplift on the total building it was found that sufficient dead loads are provided by the roof, sixth and fifth floors so that no net uplift occurs below the fifth floor.

The "Other Life Hazards" have not been calculated. The glazing, wall cladding, exterior appendages, window frames, and their anchorages are satisfactory for the usual heavy winds, but for positive and negative pressures more than twice that of most winds considerable damage should be expected. The horizontal portion of the projecting canopies at floor levels is supported by steel sections cantilevered from the main steel frame and probably would not become airborne.

The exterior steel studs of the penthouse would be expected to fail in a tornado since the stress ratio for wind analysis was high.

Reference is made to section 3.3D where these items are discussed in greater detail.

The metal deck anchorage is checked for uplift. There is no accepted value for tension on puddle welds of this type, but it appears reasonable to assume that this tension value would be approximately equal to the shear value.

DESIGN CRITERIA

LOAD CRITERIA (FROM ORIGINAL CALCULATIONS)

DEAD LOADS:

PENTHOUSE ROOF	= 91 p.s.f.
PENTHOUSE FLOOR	= 103 " INCLUDING MECHANICAL
7TH FLOOR	= 102 "
MAIN ROOF	= 75 "
2ND TO 6TH FLOOR	= 73 "
LOW ROOF	= 75 "

LIVE LOADS:

ROOFS	= 20 p.s.f.
FLOORS	= 50 p.s.f.

DEAD AND LIVE LOADS AND MOMENTS IN COLUMNS ARE FROM ORIGINAL CALCULATIONS

TORNADO CRITERIA (SEE SECTION 3.3 D)

HORIZONTAL WIND PRESSURE:

WINDWARD SIDE = 80 p.s.f.
LEEWARD SIDE = 50 p.s.f.

UPLIFT WIND PRESSURE = 172 p.s.f.

STEEL DESIGN CRITERIA

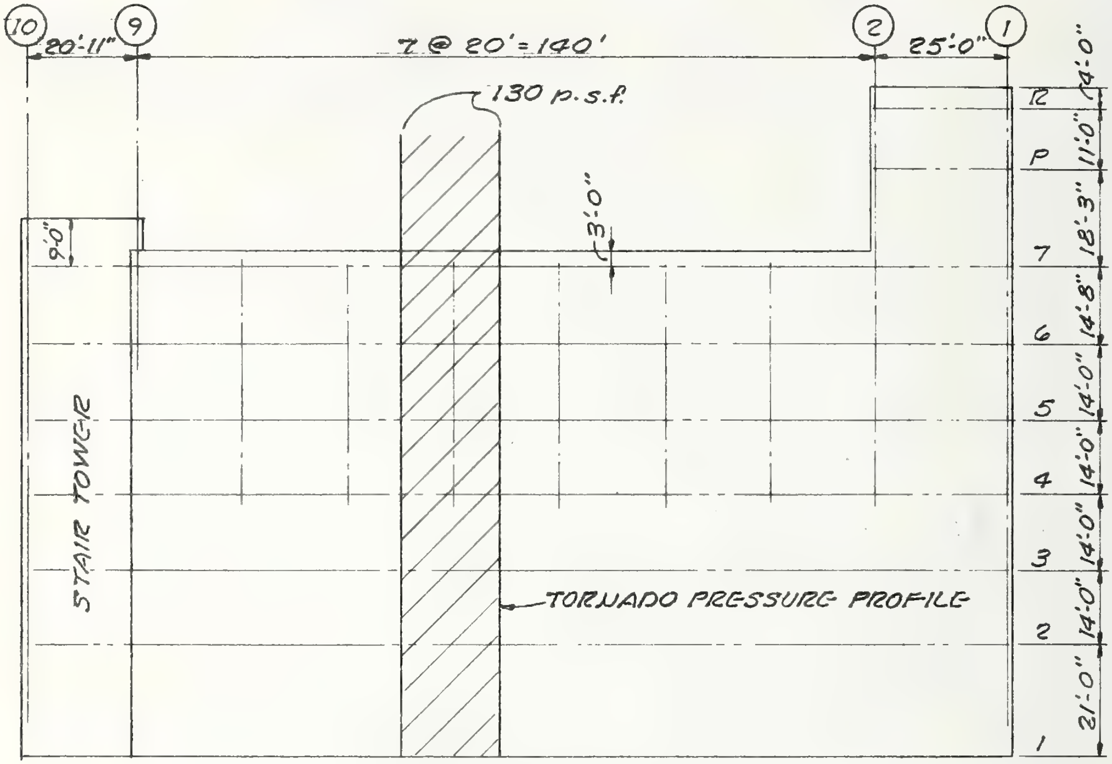
STRUCTURAL STEEL - ASTM A-7, F_y = 33 K.S.I., 1969 AISC. SPECIFICATIONS PART 2

MEMBERS TO BE CHECKED

FIRST STORY COLUMNS ON LINE 4 WHICH HAVE THE HIGHEST STRESS RATIOS INDICATED ON THE WIND ANALYSIS WILL BE CHECKED.

TORNADO ANALYSIS

TORNADO LATERAL PRESSURE DISTRIBUTION



NORTH ELEVATION

TORNADO FORCES AND SHEARS AT EACH LEVEL

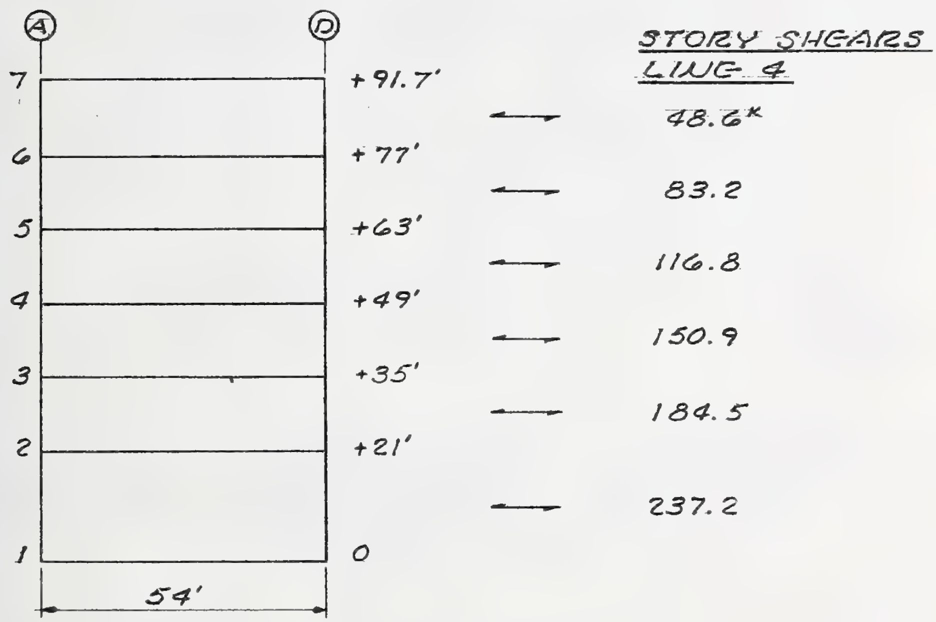
N-S TORNADO

LEVEL	HEIGHT	PRESS. p.s.f.	TRIB. HEIGHT	LENGTH	TORNADO FORCE	STORY SHEAR
R	121	130	9.5	27	33,345#	33.3K
P	110	130	14.65	27	51,422	84.8
7	91.7	130	16.5	27	57,915	
			10.35	140	188,370	377.8
			16.35	22	46,761	
6	77	130	14.35	188	350,714	228.5
5	63	130	14	188	342,160	1,070.7
4	49	130	14	188	342,160	1,412.8
3	35	130	14	188	342,160	1,755.0
2	21	130	17.5	188	427,700	2,182.7

TORNADO ANALYSIS

DISTRIBUTION OF SHEARS TO FRAME ON LINE 4

TO DETERMINE THE SHEARS TO FRAME 4 DUE TO THE TRANSVERSE (N-S) TORNADO LOADS, THE STORY SHEARS ARE DISTRIBUTED TO THE FRAME IN PROPORTION TO THEIR RELATIVE STIFFNESSES. THE STORY SHEARS, INCLUDING THE EFFECTS OF TORSION, HAVE BEEN PRORATED USING THE RALATIVE STIFFNESSES OF THE FRAMES AS SHOWN IN THE ORIGINAL CALCULATIONS. FOR EXAMPLE ON LINE 4 AT 7TH LEVEL; ORIGINAL SHEAR ON LINE 4 WAS 5.4K, ORIGINAL STORY SHEAR WAS 42K. NEW STORY SHEAR = 377.8K (SHEET 2-AM-T2) ∴ NEW LINE 4 SHEAR $= \frac{5.4}{42} \times 377.8 = 48.6^K$



OVERTURNING MOMENTS AND AXIAL LOAD ON COLUMNS

LEVEL	HEIGHT	STORY SHEAR K	OTM 'K	ΣOTM 'K	AXIAL LOAD K
7	14.7'	48.6K	714.4'K	714.4'K	13.2K
6	14.0	83.2	1164.8	1879.2	34.8
5	14.0	116.8	1635.2	3514.4	65.1
4	14.0	150.9	2112.6	5627.0	104.2
3	14.0	184.5	2583.0	8210.0	152.0
2	21.0	237.2	4981.2	13191.2	244.3

TORNADO ANALYSIS

1ST STORY COLUMNS ON LINE 4 FOR BENDING ABOUT MINOR AXIS.

COLUMN W14 x 202
A-7 STEEL $F_y = 33$ K.S.I.

$A = 59.39 \square''$
$S_{xx} = 324.9''^3$ $\quad r_{xx} = 6.54''$
$S_{yy} = 124.4''^3$ $\quad r_{yy} = 4.06''$

COLUMN ALLOWABLE STRESSES:

COLUMN LENGTH = 17' UNBRACED - BOTH DIRECTIONS
FROM 1969 AISC SPECIFICATIONS FIG. C1.8.2

$$\text{FOR } K\ell/r_x \quad G = \frac{\Sigma \frac{I_c}{L_c}}{\Sigma \frac{I_g}{L_g}} = \frac{\frac{2538}{17}}{\frac{40200}{54}} = .20 \qquad \text{FOR } K\ell/r_y \quad G = \frac{\frac{980}{17}}{\frac{40200}{20}} = .02$$

$K = 2.0$ $\quad$ X = AXIS $\qquad$ $K = 1.0$ $\quad$ Y = AXIS

$$K\ell/r_{xx} = \frac{2 \times 17 \times 12}{6.54} = 62.4 \qquad K\ell/r_{yy} = \frac{1 \times 17 \times 12}{4.06} = 50.2$$

$$C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = 131.6$$

$$F_a = \frac{\left[1 - \frac{(K\ell/r)^2}{2C_c^2}\right] F_y}{5/3 + \frac{3(K\ell/r)}{8C_c} - \frac{(K\ell/r)^3}{8C_c^3}} = \frac{\left[1 - \frac{(62.4)}{2 \times 131.6^2}\right] \times 33}{5/3 + \frac{3 \times 62.4}{8 \times 131} - \frac{(62.4)^3}{8 \times 131.6^3}} = \frac{29.29}{1.67 + .178 - .01}$$

$F_a = 15.76$ K.S.I.

$$F'_{ex} = \frac{12\pi^2 E}{23\left(K\frac{\ell_b}{r_b}\right)^2} = \frac{12 \times \pi^2 \times 29 \times 10^6}{23 \times 62.4^2} = 38.31 \text{ K.S.I.}$$

$$F'_{ey} = \frac{12\pi^2 E}{23 \times 50.2^2} = 59.2 \text{ K.S.I.}$$

FOR PLASTIC DESIGN:

$M_{px} = Z_x \times F_y = 391 \times 33 = 12{,}903''^K$ $\quad M_{py} = 198 \times 33 = 6534''^K$

TORNADO ANALYSIS

1ST STORY COLUMNS ON LINE 4 FOR BENDING ABOUT MINOR AXIS

LOADS ON COLUMNS - LINE 4 - 1ST STORY

AXIAL: DEAD PLUS LIVE = 413^K - FROM ORIGINAL CALCULATIONS
N-S OVERTURNING = 244.3^K

BENDING MOMENTS:

DEAD PLUS LIVE = 26^{IK} - FROM ORIGINAL CALCULATIONS
N-S TORNADO = 1034^{IK} - PRORATED FROM ORIGINAL CALCULATIONS
E-W BENDING = 23.4^{IK} - DUE TO TORSION OF N-S TORNADO

STRESS RATIOS FOR AXIAL AND BENDING
(SEE SHEET 2-AM-T4 FOR ALLOWABLE STRESSES)

$$P_{cr} = 1.7 A F_a = 1.7 \times 59.39 \times 15.96 = 1611.4^K \text{ (AISC 2.4-1)}$$

$$\frac{P}{P_{cr}} + \frac{C_m M_x}{\left(1-\frac{P}{P_e}\right) M_{mx}} + \frac{C_m M_y}{\left(1-\frac{P}{P_e}\right) M_{my}} \leq 1.0 \text{ (AISC 2.4-1)}$$

$$M_{mx} = \left[1.07 - \frac{(\ell/r_y)\sqrt{F_y}}{3160}\right] M_{px} = \left[1.07 - \frac{\left(\frac{17\times 72}{4.06}\right)\sqrt{33}}{3160}\right] 12{,}903 = 12627''^K$$

$$M_{my} = \left[1.07 - \frac{\left(\frac{17\times 12}{6.54}\right)\sqrt{33}}{3160}\right] \times 6534 = 6620 > 6534$$

$$P_{ex} = \left(23/12\right) A F'_{ex} = 23/12 \times 59.39 \times 38.31 = 4361^K$$

$$P_{ey} = 23/12 \times 59.39 \times 59.2 = 6739^K$$

$$\therefore \frac{413 + 244.3}{1611.4} + \frac{.85(23.4 \times 12)}{\left(1-\frac{657.3}{4361}\right)12{,}627} + \frac{.85(26+1034)\times 12}{\left(1-\frac{657.3}{6739}\right)6534} =$$

$$= .407 + .022 + 1.834 \quad \frac{f_r}{f_a} = 2.263$$

$2.263 > 1.0$ CRITICAL ABOVE PLASTIC CAPACITY

TORNADO ANALYSIS

TORNADO UPLIFT ON ROOF

TYPICAL PENTHOUSE ROOF BEAM: - W14 x 30

SPAN = 25' TRIBUTARY WIDTH = 7'-1" DEAD PLUS LIVE = 91 p.s.f.
UPLIFT LOAD = 172 p.s.f. NET UPLIFT = 172 - 91 = 81 p.s.f.

MOMENT = $\frac{25^2}{8} \times .081 \times 12 = 44.9^{K}$ STRESS = $\frac{44.9 \times 12}{41.8} = 12.9$ K.S.I.

ALLOWABLE $F_b = \frac{12 \times 10^3 C_b}{ed/A_f} = \frac{12 \times 10^3 \times 1}{25 \times 12 \times 5.37} = 7.55$ K.S.I.

FOR PLASTIC CAPACITY = $1.7 F_b = 1.7 \times 7.55 = 12.84$ K.S.I. (AISC 2.1)

STRESS RATIO = $\frac{12.9}{12.84} = 1.005$

TYPICAL ROOF TRUSS:

SPAN = 54' TRIBUTARY WIDTH = 20' DEAD LOAD = 75 p.s.f.
NET UPLIFT = 172 - 75 = 97 p.s.f. TRUSS DEPTH = 4'-6"

TRUSS MOMENT = $\frac{54^2}{8} \times .097 \times 20 = 707^{K}$ LOWER CHORD FORCE = $\frac{707}{4.5} = 157^{K}$

TRUSS LOWER CHORD 2 ⅃L 6x6x1, A = 22.0 $r_{yy} = 2.73''$ BRACED @ MIDSPAN

$L/r_y = \frac{27 \times 12}{2.73} = 118.7$ (AISC 1.5.1.3.1) $C_c = \sqrt{\frac{2\pi^2 E}{F_y}} = 131.7$

$$F_a = \frac{\left[1 - \frac{118.7^2}{2 \times 131.7^2}\right] \times 33}{5/3 + \frac{3 \times 118.7}{8 \times 131.7} - \frac{118.7^3}{8 \times 131.7^3}} = 10.09 \text{ K.S.I.}$$

PLASTIC CAPACITY = $1.7 \times 22 \times 10.09 = 377.4^{K}$

STRESS RATIO = $\frac{157}{377.4} = .416$

UPLIFT ON TOTAL BUILDING

THE DEAD LOADS AVAILABLE IN THE ROOF, 6TH AND 5TH FLOORS EQUALS 75 + 73 + 73 = 221 p.s.f. WHICH EXCEEDS THE TORNADO UPLIFT LOAD OF 172 p.s.f. ON THE ROOF. THERE WILL BE NO NET UPLIFT FORCES BELOW THE 5TH FLOOR.

TORNADO ANALYSIS

UPLIFT ON STEEL ROOF DECK

MAXIMUM SPAN = 7'-1" DEAD LOAD = 91 p.s.f.

UPLIFT LOAD = 172 p.s.f. - NET UPLIFT = 172 - 91 = 81 p.s.f.

SINCE STEEL DECK WAS ORIGINALLY DESIGNED FOR 91 p.s.f. DOWNWARD VERTICAL LOAD, IT IS THEREFORE GOOD FOR 81 p.s.f. UPWARD LOAD. ∴ STRESS RATIO < 1.0 IN FLEXURE.

CHECKING PUDDLE WELD ATTACHMENT:

PLANS CALL FOR 3 PUDDLE PER 2' WIDE SHEET.

TRIBUTARY UPLIFT LOAD PER WELD $= \frac{7.1 \times 81 \times 2}{3} = 383^{\#}$

ASSUME UPLIFT CAPACITY OF PUDDLE WELDS EQUAL THEIR SHEAR CAPACITY. FROM TRISERVCE MANUAL, Eq. 5-6-1

ULTIMATE CAPACITY $= 46000\,t \times \underbrace{2}_{\text{FACTOR FOR ULTIMATE CAPACITY}} = 4420^{\#}$

$t = .048"$ (18 GAGE)

$\therefore$ STRESS RATIO $= \frac{383}{4420} = .086$ NOT CRITICAL

FACILITY NO. EXAMPLE 2 FORM AMD-1

APPROXIMATE ANALYTICAL METHOD
RATING FORM - TORNADOES

SYSTEMS CRITICAL STRESS RATIOS*

SYSTEM	f_T/f_a **
Roof	TRUSS-4 WT. BM. 1.0
Roof Anchorage	< 1.0
Floor	NOT CHECKED
Floor Anchorage	" "
Vertical Resisting Element	2.3
Anchorage to Footings	< 1.0
Footings	< 1.0

*Use highest Critical Stress Ratio.
For Structural Systems Rating - Tornado, see Form AME.

**f_T = Capacity required to resist tornado forces.

f_a = Capacity based on design criteria.

FACILITY NO. EXAMPLE 2

FORM AMD-2

APPROXIMATE ANALYTICAL METHOD
OTHER LIFE HAZARDS - TORNADO RATING - NOT COMPUTED

TYPE OF RISK	CRITICAL STRESS RATIO	RATING
Glass Breakage*		
Glazing*		
Window Frame Anchorage		
Wall Cladding Anchorage		
Anchorage of Exterior Appendages		
Exposed Walls		
Canopies & Eaves		

POTENTIAL MISSILES FROM OUTSIDE OF STRUCTURE*

TYPE	QUANTITY	DISTANCE

*See Instructions for ratings.

CRITICAL STRESS RATIO	RATING
< 2.0	Good
2.0 to 3.0	Fair
> 3.0	Poor

F. Resume

Earthquake

This building has been evaluated for an earthquake of MMI 9.5 which is quite severe. It rates "Fair" in its capacity to resist this earthquake and would rate "Good" for earthquakes of lesser intensity.

The Stair and Exit Enclosures rate "Good" for earthquake. Except for the unbraced ceilings and light fixtures, the Other Life Hazards are rated "Good."

Wind

This building has been evaluated for a Basic Wind Speed of 90 mph with Exposure "B." The Structural Systems rating is "Fair." The Other Life Hazards are rated "Good" except the high steel stud penthouse walls which are rated "Fair." No potential wind blown missiles were noted near this site.

Tornado

This building has been evaluated for moderate resistance to Tornado using an uplift force of 172 psf on the roof and a direct horizontal force of 130 psf on the building as a whole. Ultimate capacities were used for f_a values. The highest stress ratio was found to be in the first story column on Line 4. The f_T/f_a ratio is 2.3 and the rating for Tornado is "Fair."

Other Life Hazards from Tornado were not calculated in this example, but from experience and judgment it is probable that a good deal of glass would be lost and that there would be considerable damage to exterior metal stud and plaster walls and the exterior appendages.

It is noted that the Tornado rating of "Fair" is the same as that for Wind, even though the Tornado forces are much greater than the Wind forces. This is because consideration is given to the short duration of Tornado forces and the probability that Tornado forces will not act on all of the building at the same time with the same intensity.

The calculations show that the metal deck will not be stripped off due to the Tornado suction. However, little is known about the bond of concrete to metal decks and it is probable that some of the concrete fill would be stripped from the metal deck.

The attachment of the roofing felts to the concrete could not be determined from the plans and specifications. If not unusually well mopped down, it is possible that the roofing would be stripped from the concrete topping if subjected to suction forces from a tornado.

APPROXIMATE ANALYTICAL METHOD
CRITICAL STRESS RATIOS - STRUCTURAL SYSTEMS

	Critical Stress Ratio	Rating
Earthquake	1.06	FAIR
Wind	1.1	FAIR
Tornado	2.3	FAIR

RATING OF CRITICAL STRESS RATIOS

Critical Stress Ratio	Earthquake or Wind	Tornado
Less than 1.0	Good	Good
1 to 1.5	Fair	Good
1.5 to 2.0	Poor	Good
2.0 to 3.0	Very Poor	Fair
3.0 to 4.0	Very Poor	Poor
Over 4.0	Very Poor	Very Poor

D.4 EXAMPLE 3

A. GENERAL DISCUSSION

This example is a building simulation to demonstrate in the most simple fashion the manner in which buildings having irregularities in dynamic characteristics will be analyzed for earthquake resistance using the Approximate Analytical Evaluation Method. A portion of a long 4-story building is assumed to have moment-resistant frames in both directions. The building is also assumed to have shear walls as a primary shear resisting system above the second floor in the transverse direction.

In order to determine the equivalent size of force input to evaluate the building, it is assumed that the 1973 UBC base shear factor $C = \frac{.05}{\sqrt[3]{T}}$ for a building with uniform dynamic characteristics can be approximated by a single degree-of-freedom spectrum of $S_{ma} = \frac{.06g}{\sqrt[4]{Tm}} = 0.10g$. In other words, if the modal responses of a dynamically uniform building to the empirical single degree-of-freedom spectra are combined by the method of the square root of the sum of the squares, the resulting multi-degree of freedom response will be approximately that specified in 1973 UBC. If other spectra are determined as being appropriate for comparison with code design resistances (see section 3.4), these may also be used. The example is carried out to the point of indicating the shears and moments to be used for evaluation.

EXAMPLE 3

DESIGN CRITERIA

1) SEISMIC ZONE 1
   $Z = 1.0$

2) MAXIMUM ALLOWABLE
   DRIFT = .003

3) LOADING

   ROOF L.L = 20 #/□'
   FLOOR L.L = 50 #/□'

   8" SHEAR WALL – 100 #/□'

   ROOF D.L

ROOF	70 #/□'
OVERHANG	50 #/□'

   FLOOR D.L

FLOOR	90 #/□'
OVERHANG	60 #/□'
RAILING	100 #/FT.

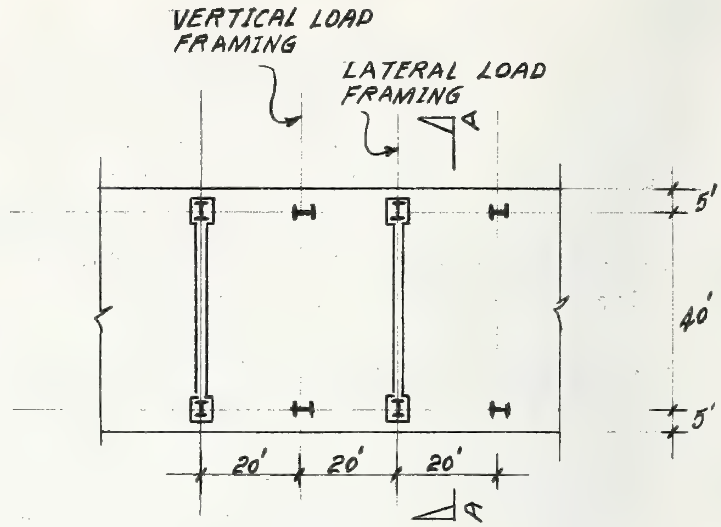
4) PROPERTIES OF MATERIALS

   CONCRETE

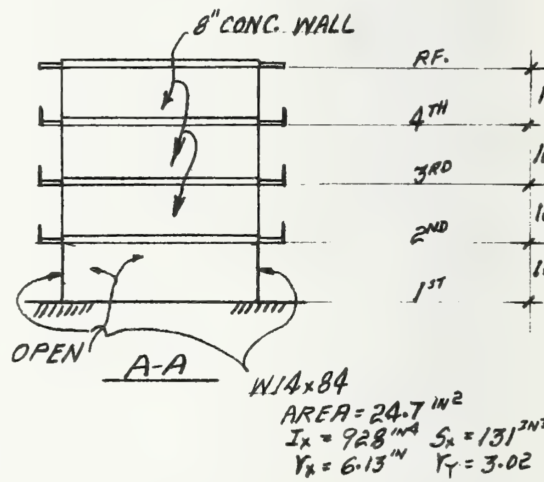
   $f'_c = 4000$ PSI ; $E_c = 3.64 \times 10^6$ PSI

   STRUCTURAL STEEL

   $F_Y = 36000$ PSI ; $E_S = 29 \times 10^6$ PSI



PLAN



A-A

PROCEDURE

1) FIND MASS [m] MATRIX (UNITS – K/IN/SEC²)

$$w_R = (70 \times 40 \times 40 + 50 \times 2 \times 40 \times 5 + 100 \times 40 \times 6)/1000 = 156^K$$

$$w_4 = w_3 = (90 \times 40 \times 40 + 60 \times 2 \times 40 \times 5 + 100 \times 40 \times 12 + 100 \times 2 \times 40)/1000 = 224^K$$

$$w_2 = (90 \times 40 \times 40 + 60 \times 2 \times 40 \times 5 + 100 \times 40 \times 6 + 100 \times 2 \times 40)/1000 = 200^K$$

WHERE w – TRIBUTARY DEAD LOAD TO LATERAL LOAD FRAMING.
MASS: $m = w/g$ – ($g = 386.4$ IN/SEC²)

$$[m]_{N\times N} = \frac{1}{386.4}\begin{bmatrix} 156 & & & \\ & 224 & & \\ & & 224 & \\ & & & 200 \end{bmatrix}_{4\times4} = \begin{bmatrix} .40373 & & & \\ & .57971 & & \\ & & .57971 & \\ & & & .51760 \end{bmatrix}_{4\times4}$$

N: NO. OF STORIES

2) FIND FLEXIBILITY [a] MATRIX (h - HEIGHT OF WALL)

a) DEFLECTION OF SHEAR WALL FOR $P=1^K$ (NEGLECT COLUMN AXIAL DEFORMATIONS)

$$\Delta = \frac{Ph^3}{3EI} + \frac{1.2Ph}{.4EA} = \frac{1\times12^3\times12^3}{3\times3.64\times10^3\times\frac{8\times(40\times12)^3}{12}} + \frac{1.2\times1\times(12\times12)}{.4\times3.64\times10^3\times(8\times40\times12)}$$

$$= .0000037 + .0000309 = .0000346^{IN}$$

b) DEFLECTION OF 1^{ST} STORY FOR $P=1^K$ (ASSUME 2 COLUMNS AS GUIDED CANTILEVERS)

$$\Delta = \frac{2Ph^3}{3EI} = \frac{2\times(1/2)\times(12/2)^3\times12^3}{3\times29000\times928} = .0046230^{IN}$$

c) FLEXIBILITY MATRIX ASSUMING NO ROTATION AT FLOORS.

$$[a]_{N\times N} = \begin{bmatrix} .0046230 & .0046230 & .0046230 & .0046230 \\ .0046230 & .0046576 & .0046576 & .0046576 \\ .0046230 & .0046576 & .0046922 & .0046922 \\ .0046230 & .0046576 & .0046922 & .0047268 \end{bmatrix}_{4\times4}$$

3) ASSUME SHAPES $[\Phi]$ FOR DESIRED MODES (NORMALIZED AT TOP FLOOR)

$$[\Phi]_{N\times K} = \begin{bmatrix} .990 & 1.026 & 1.099 & 1.210 \\ .995 & .471 & -.850 & -2.276 \\ .998 & -.395 & -.968 & 2.191 \\ 1.000 & -1.000 & 1.000 & -1.000 \end{bmatrix}_{4\times4}$$

K: NO. OF DESIRED MODES

4) CALCULATE GENERALIZED MASS $[\mathcal{M}]$ MATRIX

$$[\mathcal{M}]_{K\times K} = [\Phi]^T_{K\times N}\,[m]_{N\times N}\,[\Phi]_{N\times K}$$

5) CALCULATE GENERALIZED STIFFNESS [k] MATRIX

$$[k]_{K\times K} = \omega^4 [G]_{K\times K} = \omega^4 [\Phi]^T_{K\times N} [m]_{N\times N} [a]_{N\times N} [m]_{N\times N} [\Phi]_{N\times K}$$

ω: FREQUENCY

6) GENERALIZED EQUATION OF MOTION

$$[m]\{q\} = \omega^2 [G]\{q\}$$

q: NORMAL COORDINATES

WHICH IS PREMULTIPLIED BY $[m]^{-1}$ AND REARRANGED TO

$$\left([D] - \frac{1}{\omega^2}[I]\right)\{q\} = 0 \quad -- \quad \text{WHERE } [D] = [m]^{-1}[G]$$

7) SOLVE EIGENVALUE PROBLEM FOR NATURAL FREQUENCIES AND THUS PERIODS AND MODE SHAPES

STEPS 4 THRU 7 HAVE BEEN CARRIED OUT BY A COMPUTER PROGRAM FOR THIS EXAMPLE.

```
EXAMPLE      4
  PROGRAM FRESH
  FREQUENCY AND MODE SHAPES BY INFLUENCE COEFF.

  INPUT DATA
  ------


  DIAGONAL MASS MATRIX
 .40373   .57971   .57971   .5176
  FLEXIBILITY MATRIX
 .4623E-02   .4623E-02   .4623E-02   .4623E-02
 .4623E-02   .46576E-02     .46576E-02     .46476E-02
 .4623E-02   .46576E-02     .46922E-02     .46922E-02
 .4623E-02   .46576E-02     .46922E-02     .47268E-02

  ASSUMED SHAPES FOR DESIRED MODES
 .99   1.026    1.099    1.21
 .995     .471    -.85  -2.276
 .998    -.395    -.968     2.191
 1    -1      1    -1
```

3-E4

```
OUTPUT
------

 MODE NO.     1
FREQUENCY=     10.1583   RAD/SEC.
 NORMAL COORDINATES
   19 ITERATIONS    20 ITERATIONS
   1.0000000E+00    1.0000000E+00
   2.0085347E-15    2.0085347E-15
   1.1086341E-15    1.1086341E-15
   2.2389059E-16    2.2389059E-16
 MODE SHAPE
.98826599
.99423791
.99815195
1

 <<<<<<>>>>>>


 MODE NO.     2
FREQUENCY=    188.7649   RAD/SEC.
 NORMAL COORDINATES
   19 ITERATIONS    20 ITERATIONS
   4.2399100E-13    4.2399100E-13
   1.0000000E+00    1.0000000E+00
   1.8948193E-13    1.8948193E-13
   1.4337807E-14    1.4337807E-14
 MODE SHAPE
1.0493652
.53489924
-.36186431
-1

 <<<<<<>>>>>>

 MODE NO.     3
FREQUENCY=    336.9828   RAD/SEC.
 NORMAL COORDINATES
   19 ITERATIONS    20 ITERATIONS
   1.2473371E-07    1.2474247E-07
   3.6632386E-07    3.6634957E-07
   1.0000000E+00    1.0000000E+00
   3.2633389E-06    3.2635679E-06
 MODE SHAPE
1.2316926
-.71291092
-1.0336953
1

 <<<<<<>>>>>>
```

```
 MODE NO.      4
FREQUENCY=    422.0068   RAD/SEC.
 NORMAL COORDINATES
   19 ITERATIONS    20 ITERATIONS
   3.822244L2E-02   3.8224412E-02
   1.1225374E-01    1.1225374E-01
   1.4099453E-01    1.4099453E-01
   1.0000000E+00    1.0000000E+00
 MODE SHAPE
 1.6497059
-2.4419968
 2.1894015
-1

 <<<<<<>>>>>>

RUN COMPLETE.
```

FROM COMPUTER OUTPUT THE FREQUENCIES (radians/SEC.) are:

$f_1 = 10.1583$ $\quad f_2 = 188.7649$ $\quad f_3 = 336.9828$ $\quad f_4 = 422.0068$

$\therefore\ T_1 = \frac{2\pi}{f_1} = .6186^{SEC.}$ $\quad T_2 = \frac{2\pi}{f_2} = .0333^{SEC.}$ $\quad T_3 = \frac{2\pi}{f_3} = .0186^{SEC.}$ $\quad T_4 = \frac{2\pi}{f_4} = .0149^{SEC.}$

8) SPECTRAL MODAL ANALYSIS

$$V_m = \frac{W_m}{g} \cdot S_{ma} \quad ; \quad W_m = \frac{(\Sigma\, \phi_{mx}\, w_x)^2}{\Sigma\, \phi_{mx}^2\, w_x} \quad ; \quad S_{ma} = \frac{.06}{4\sqrt{T_m}} \cdot g \leq .10g$$

$$F_{mx} = \frac{V_m w_x \phi_x}{\Sigma\, w_x \phi_x}$$

WHERE

V_m = BASE SHEAR FOR MODE m.

W_m = WEIGHT OF STRUCTURE EQUIVALENT TO A SINGLE MASS OSCILLATOR FOR MODE m.

w_x = WEIGHT OF STRUCTURE AT LEVEL X.

ϕ_{mx} = VALUE OF MODE SHAPE FOR MODE m AT LEVEL X.

S_{ma} = SPECTRAL ACCELERATION FOR MODE m.

F_{mx} = FORCE ON THE STRUCTURE FOR MODE m AT LEVEL X.

T_m = NATURAL PERIOD IN MODE m.

$$S_{1a} = \frac{.06}{4\sqrt{.6186}} \times 32.2 \times 12 = 26.14^{IN/SEC^2}$$

$$S_{2a} = \frac{.06}{4\sqrt{.0333}} \times 32.2 \times 12 = 54.27 > .10g(38.64);\ \therefore\ S_{2a} = 38.64^{IN/SEC^2}$$

SIMILARLY

$$S_{3a} = S_{4a} = 38.64^{IN/SEC^2}$$

STEP 8 HAS BEEN CARRIED OUT BY A COMPUTER PROGRAM FOR THIS EXAMPLE.

EXAMPLE 4

FLEXIBILITY MATRIX

4.62300E-03	4.62300E-03	4.62300E-03	4.62300E-03
4.62300E-03	4.65760E-03	4.65760E-03	4.65760E-03
4.62300E-03	4.65760E-03	4.69220E-03	4.69220E-03
4.62300E-03	4.65760E-03	4.69220E-03	4.72680E-03

>>RESPONSE TO MODE NO. 1

SPECTRAL ACCELERATION 26.140 IN./SEC./SEC.

LEVEL	HX(IN)	WX(K)	PX	FX(K)	VX(K)	OTM(IN-K)	DEFL(IN)
4	144	156	1.000	10.6	10.6	1529	.2543
3	144	224	.998	15.2	25.8	5248	.2540
2	144	224	.994	15.2	41.0	11149	.2531
1	144	200	.988	13.4	54.4	18988	.2516

>>RESPONSE TO MODE NO. 2

SPECTRAL ACCELERATION 38.640 IN./SEC./SEC.

LEVEL	HX(IN)	WX(K)	PX	FX(K)	VX(K)	OTM(IN-K)	DEFL(IN)
4	144	156	-1.000	-3.1	-3.1	-443	.0081
3	144	224	-.362	-1.6	-4.7	-1117	.0082
2	144	224	.535	2.4	-2.3	-1450	.0084
1	144	200	1.049	4.1	1.8	-1187	.0085

>>RESPONSE TO MODE NO. 3

SPECTRAL ACCELERATION 38.640 IN./SEC./SEC.

LEVEL	HX(IN)	WX(K)	PX	FX(K)	VX(K)	OTM(IN-K)	DEFL(IN)
4	144	156	1.000	.2	.2	31	.0001
3	144	224	-1.034	-.3	-.1	16	.0001
2	144	224	-.713	-.2	-.3	-30	.0001
1	144	200	1.232	.3	.0	-28	.0001

>>RESPONSE TO MODE NO. 4

SPECTRAL ACCELERATION 38.640 IN./SEC./SEC.

LEVEL	HX(IN)	WX(K)	PX	FX(K)	VX(K)	OTM(IN-K)	DEFL(IN)
4	144	156	-1.000	-.6	-.6	-85	.0020
3	144	224	2.189	1.9	1.3	97	.0021
2	144	224	-2.442	-2.1	-.8	-19	.0020
1	144	200	1.650	1.2	.4	45	.0020

--SUMMARY--

LEVEL	ROOT OF SUM OF THE SQUARES			ABS SUM OF TWO LARGEST MODES		
NO	SHEAR(K)	OTM(IN-K)	DEFL(IN)	SHEAR(K)	OTM(IN-K)	DEFL(IN)
4	11.1	1594	.2545	13.7	1972	.2624
3	26.3	5366	.2541	30.5	6365	.2622
2	41.1	11243	.2532	43.3	12600	.2614
1	54.5	19025	.2518	56.3	20175	.2601

RUN COMPLETE.

COMPUTER OUTPUT NOTATIONS

HX	=	FLOOR HEIGHT
WX	=	TRIBUTARY FLOOR WEIGHT
PX	=	MODE SHAPE (ϕ_{mx})
FX	=	LATERAL FORCE APPLIED TO THE FLOOR (F_{mx})
Vx	=	TOTAL LATERAL SHEAR AT THE FLOOR
OTM	=	TOTAL OVERTURNING MOMENT AT THE FLOOR
DEFL	=	DEFLECTION OF THE FLOOR WITH RESPECT TO THE BASE

9) CHECK SHEAR WALL

$$V_u = .75 \times 1.7 \times 1.1 (41.1) = 57.64^K$$

SHEAR STRESS IN 2ND FLOOR WALL

$$v_u = \frac{V_u}{\phi h d}$$

$$= \frac{57.64 \times 1000}{.85 \times 8 \times (.8 \times 40 \times 12)}$$

$$= 22 \text{ PSI (NOT CRITICAL)}$$

10) CHECK W14x84 COLUMN

AXIAL LOADS IN COLUMNS

D.L

RF. $(70\times20\times20+50\times5\times20+100\times20\times6)/1000 = 45^K$

4^{TH} $(90\times20\times20+60\times5\times20+100\times20\times12+100\times20)/1000 = 68^K$

3^{RD} " " " $= 68^K$

2^{ND} $(90\times20\times20+60\times5\times20+100\times20\times6+100\times20)/1000 = 56^K$

$\Sigma\ 237^K$

L.L (USING REDUCED L.L FOR, ROOF 12#/□' & FLOOR 20#/□')

ROOF $12(20\times20+20\times5)/1000 = 6^K$

FLOORS (4^{TH}, 3^{RD}, 2^{ND}) $3\times20(20\times20+20\times5) = 30^K$

$\Sigma\ 36^K$

OVERTURNING (SEISMIC)

$$= \frac{19025}{40\times12} = 39.6^K$$

$$(f_a)_{D.L+L.L} = \frac{237+36}{24.7} = 11.05\ KSI \qquad (f_a)_{SEIS.} = \frac{39.6}{24.7} = 1.60\ KSI$$

$$M_{SEIS.} = \left(\frac{54.5}{2}\right)\times6\times12 = 1962^{IN\text{-}K} \qquad (f_b)_{SEIS.} = \frac{1962}{131} = 14.98\ KSI$$

ALLOWABLE STRESSES FOR W14x84 ($L_c = 12.7'$)

$$\frac{Kl}{r_Y} = \frac{1.0\times10\times12}{3.02} = 39.7\ ;\ \frac{Kl}{r_x} = \frac{1.0\times10\times12}{6.13} = 19.6$$

$F_a = 19.21$ KSI ; $F'_{ex} = 388.8$ KSI ; $F_b = 24$ KSI

a) COMBINED STRESS

$$= \frac{11.05}{19.21} + \frac{1.60}{19.21} + \frac{.85 \times 14.98}{\left(1 - \frac{12.66}{388.8}\right)24} = .575 + .083 + .548$$

$$= 1.206 < 1.333 \quad \text{O.K}$$

b) CRITICAL STRESS RATIO

$$= \frac{.083 + .548}{1.333 - .575} = \underline{.832}$$

II) 1ST STORY DRIFT (ASSUME 2 COLUMNS AS GUIDED CANTILEVERS)

$$\text{DRIFT} = \frac{2 \times Pl^3/3EI}{12 \times 12}$$

$$= \frac{2 \times \left(\frac{54.5}{2}\right) \times 6^3 \times 12^3 / 3 \times 29000 \times 928}{12 \times 12} = .0017 < .003 \quad \text{O.K}$$

D.5 BUILDINGS USED TO DEMONSTRATE THE DETAILED ANALYTICAL EVALUATION METHOD

A. Earthquake Damage Evaluation Buildings

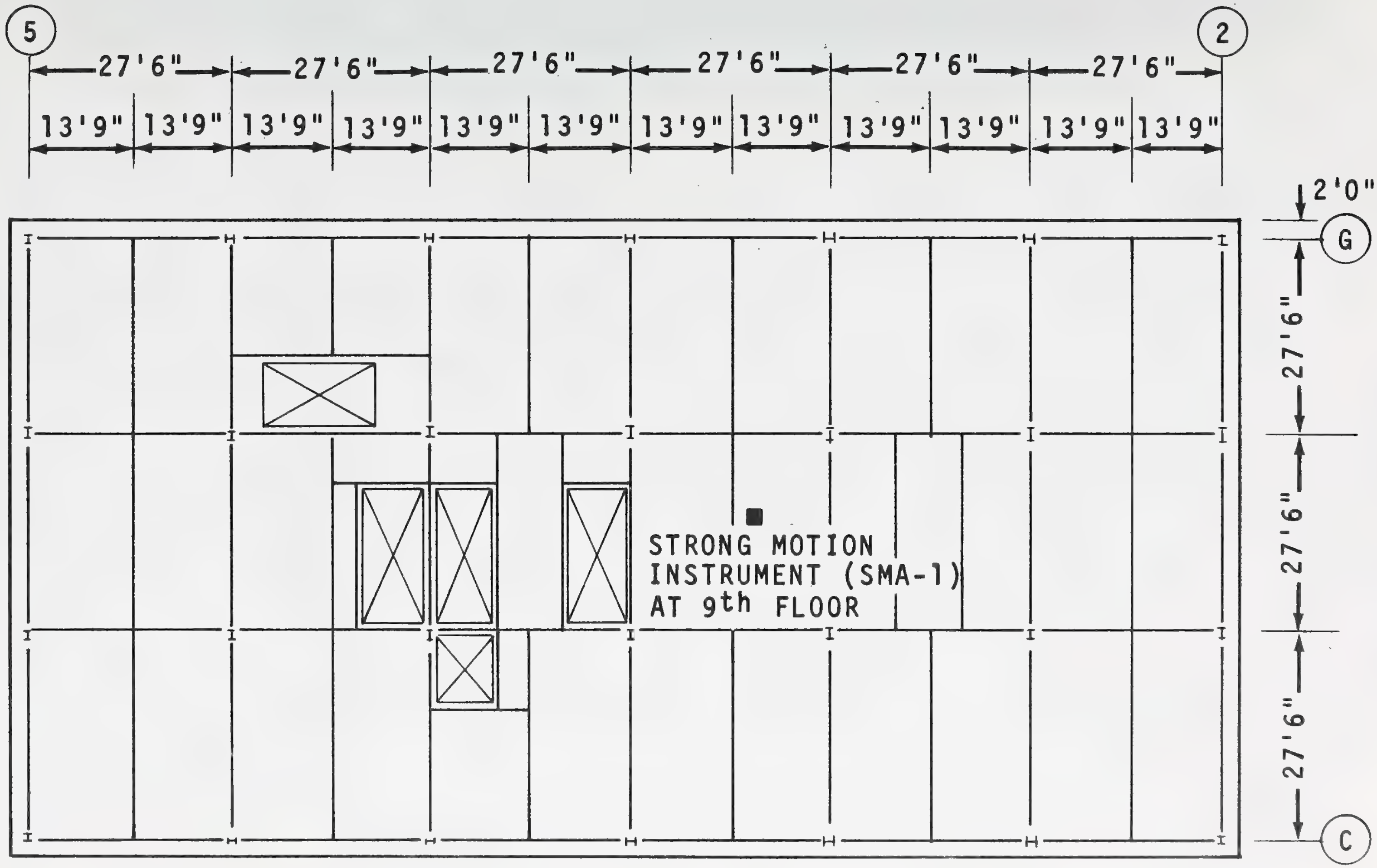
The buildings used in these example problems are each described in detail in [D.1]. Six general structural types have been studied. The types are: (1) Moment Resisting Steel Frame, (2) Braced Steel Frame, (3) Moment Resisting Concrete Frame, (4) Concrete Shear Wall, (5) Concrete Frame with Infill Walls and (6) Masonry Load Bearing. Since the damage in each of these buildings is to be evaluated for the San Fernando Earthquake -- February 9, 1971, each section presents a brief qualitative summary of building damage.

Steel Frame Building - Moment Resisting

This steel building is described in [D.1] in a technical paper by William E. Gates entitled Building Report No. 32. The paper presented the results of a detailed analytical model of the building and compared the calculated dynamic response with that recorded on strong motion instruments during the San Fernando earthquake. Earthquake and ambient natural periods for this building are available in [3.50] and [3.51].

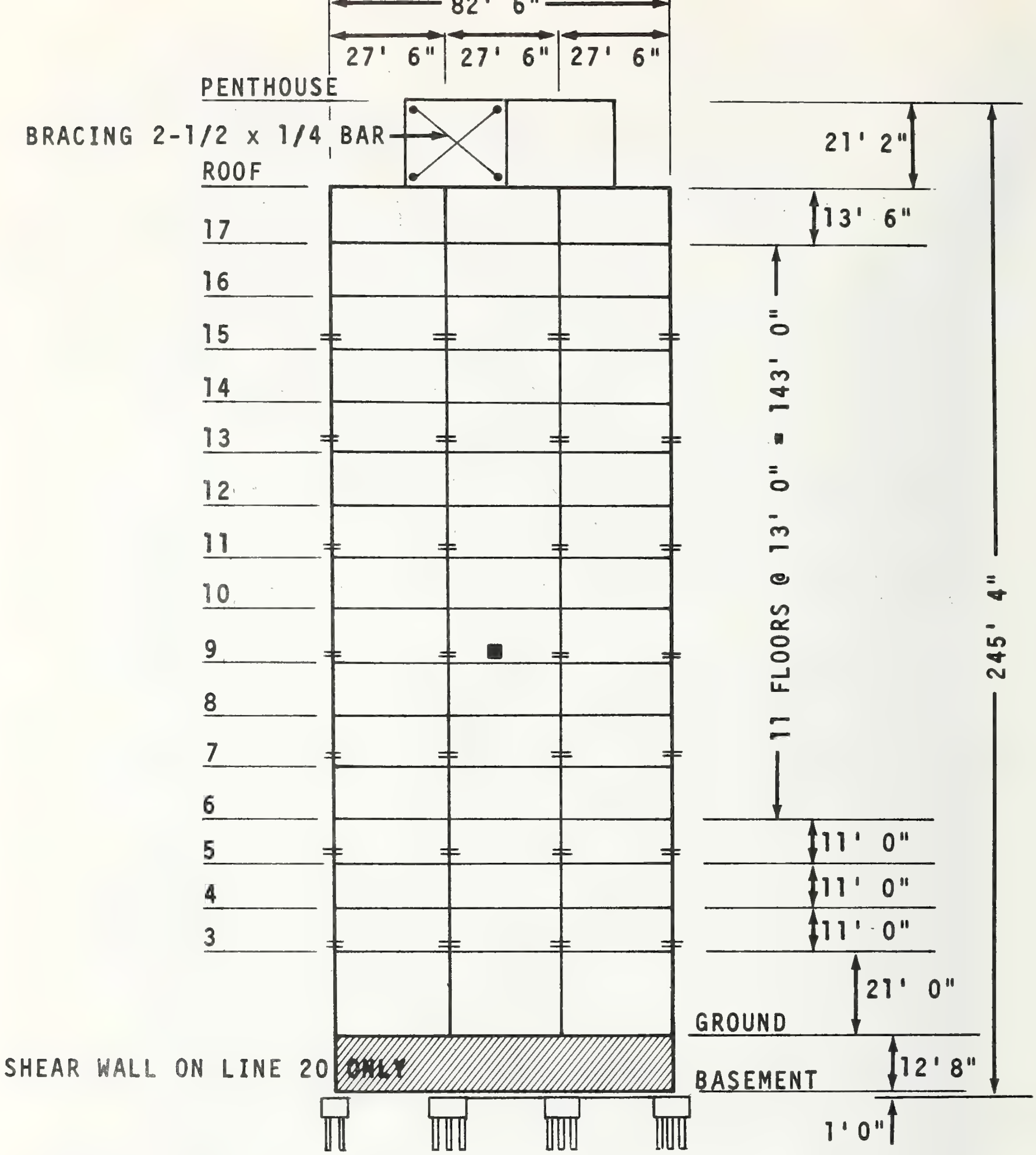
Building No. 32 is a 16 story office building. A typical floor plan is shown in figure D.1 with North-South and East-West elevations shown in figure D.2. The vertical load carrying system is a three-dimensional steel space frame. Lightweight concrete slabs are used in composite construction with the beams of the frame to support the floor loads and to form a rigid floor diaphragm under lateral forces. The four frames around the perimeter resist all lateral forces as moment resisting frames. The frames are constructed from deep welded plate girders and standard wide-flange columns. All connections are full moment connections obtained by welding the girder flanges and web to the column.

Estimated cost of the building when constructed in 1970 was four million dollars. The building is located in the San Fernando Valley and is approximately 17 miles from the February 9, 1971 San Fernando earthquake epicenter. Soil site conditions are mainly clayey sands and silty sands. The building rests on Raymond step-tapered piles averaging 54 feet in length. Peak ground acceleration in the longitudinal and transverse directions during the San Fernando earthquake were 13.2 and 15.3 percent gravity, respectively. Corresponding peak roof accelerations were 22.0 and 23.1 percent, respectively.



TYPICAL TOWER FLOOR FRAMING PLAN

Figure D-1 Plan View - Building No. 32



LEGEND:

PINNED CONNECTION

COLUMN SPLICE

STRONG MOTION INSTRUMENT

Figure D-2a North-South Frames on Lines '5' and '20'-
Building No. 32

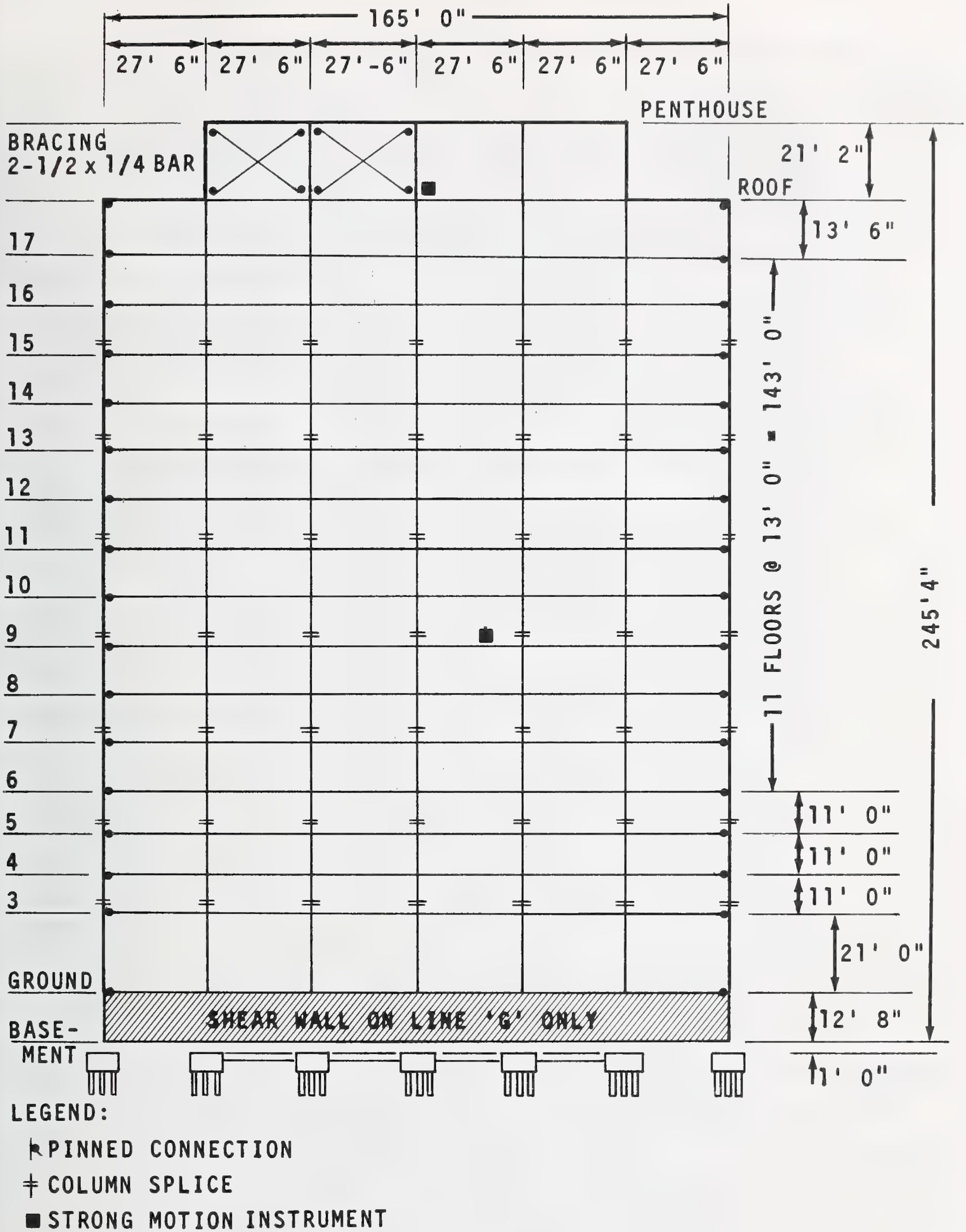


Figure D.2b East-West Frames on Lines 'C' and 'G' --
Building No. 32

The following conclusions are quoted from the paper by William E. Gates:

" 1. Calculated first mode, dynamic force response exceeded current 1970 Uniform Building Code seismic force values by 70% in the North-South direction, and by 120% in the East-West direction.

2. The envelope of dynamic maximum force response exceeds current code design forces by an average value of 110% in the North-South direction, and by 170% in the East-West direction.

3. Maximum stress levels in 30% of the members in the North-South frames were calculated to have exceeded yield values at least once during the earthquake. In the East-West direction, 80% of the lateral force resisting members were calculated to have exceeded initial yield stress.

4. Columns reached initial yield stress before the girders.

5. The general performance of the structure was linear-elastic with only minor lengthening of building periods during the earthquake.

6. A significant portion of the maximum building response was in the second and third modes. In fact, the story forces produced by the second and third modes exceeded the first mode values in both of the horizontal directions of building motion.

7. Structural damping was found to vary from mode to mode with the higher damping values associated with the longer period or fundamental modes.

8. The office tower and adjacent parking structure are known to have impacted at the 5th floor level during major North-South building motion. This was evident by the marks left from building pounding at the seismic separation.

9. The influence of local soil conditions upon the ground motions recorded at the site was distinctly evident in the North-South response spectrum. Site amplification effects would have easily doubled the forces produced by this earthquake in a building constructed at the site with a fundamental period of 1.7 seconds.

10. Vertical roof accelerations equaled the horizontal acceleration, indicating that vertical amplification of ground motion can be significant.

11. No structural damage occurred during the earthquake. Non-structural damage to drywall, seismic closures, and equipment supports amounted to an estimated $3,000 in repairs or roughly one cent per square foot of usable building space." [D.1]

<u>Steel Frame Building -- Lateral Bracing</u>

This building is described in [D.1] in a paper by Gary C. Hart entitled Building Report No. 37. The building is located approximately 24 miles from the San Fernando earthquake epicenter and is 19 stories above ground. There are four parking levels below ground level and the foundation rests upon steel piles averaging approximately 72 feet in depth. The building is located in the southern California building complex known as Century City. The building was built in 1967 at an estimated cost of 17 million dollars.

Figures D.3 and D.4 show plan and elevation views of the building. Lateral forces are resisted in the East-West direction by four moment resisting frames. However, in the North-South direction, five cross-braced steel frames resist all lateral forces.

Peak basement accelerations in the longitudinal and transverse directions during the San Fernando earthquake were recorded to be 17 and 14 percent of gravity, respectively. Corresponding roof peak accelerations were 7 and 14 percent, respectively.

A detailed damage survey was carried out on this building after the San Fernando earthquake, see [D.2] and table D.1.

Table D.1 SAN FERNANDO EARTHQUAKE LOSS BUILDING NO. 37 [D.2]

I. OWNER INCURRED REPAIR COSTS	
Repair three corner sofitts over podium around building	$ 761.00
Ground floor broken window replacement	113.00
Repair corridor vinyl wall covering damage	337.00
Ceiling Tile replacement, labor	969.00
Ceiling tile replacement, materials	2,000.00
Subtotal Repair Costs (a)	$4,180.00
II. OWNER INCURRED PAINTING COSTS	
Stairwells	$8,400.00
Suites 938, 1261, 1401, 540. 670, 1521, 1145	270.00
Suite 1800	250.00
Suite 1500	35.00
Suite 750	480.00
Suite 800	100.00
Suite 590	69.00
Subtotal Painting Cost (b)	$9,604.00
TOTAL OWNER INCURRED NON-STRUCTURAL COSTS (a + b)	$13,784.00
III. OCCUPANT INCURRED OFFICE CLEAN-UP COSTS	$ 5,604.00

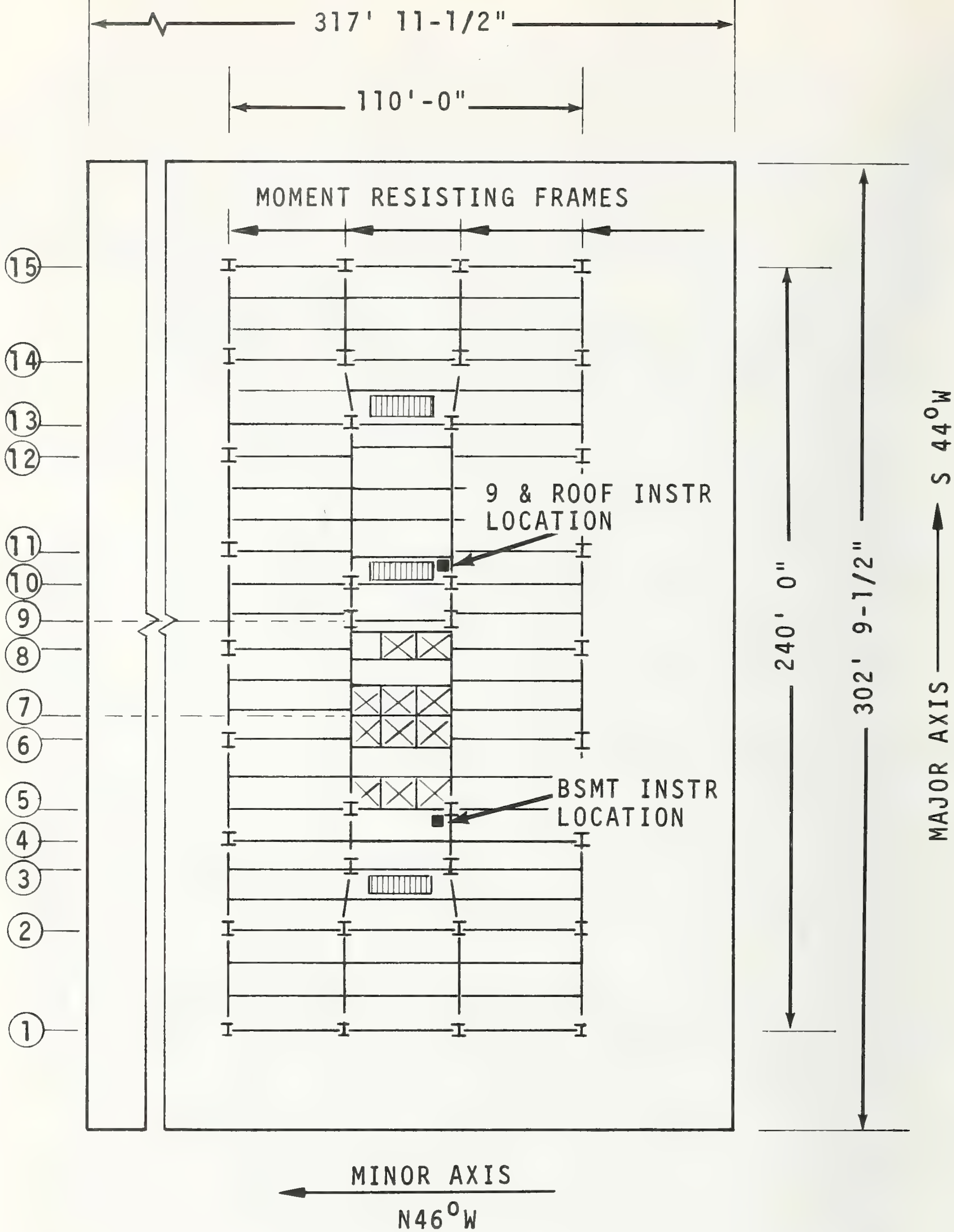


Figure D.3 Typical Floor Plan - Building No. 37

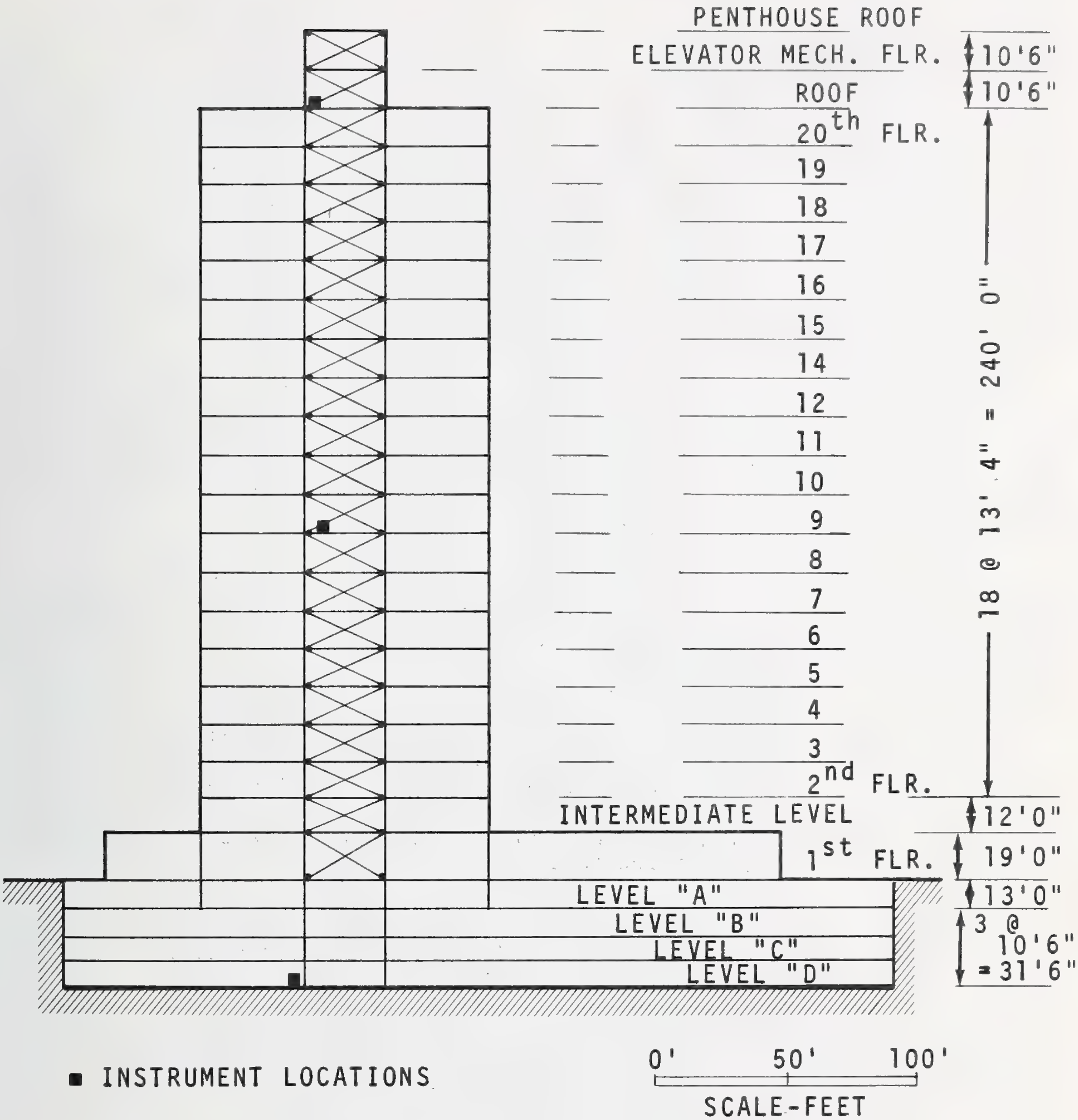


Figure D.4 Elevation of N46°W Frame -- Building No. 37

Concrete Frame Building -- Moment Resisting

Reference [D.1] contains a paper entitled Building No. 28 by John A. Blume and Associates which describes the earthquake response of a twelve story reinforced concrete building to the San Fernando earthquake. The building is located approximately 17 miles from the earthquake epicenter and incurred repair costs of $44,000. Of this loss, approximately $12,000 was structural damage. It is to be noted that while not stated in the cited paper the fourth through seventh floors were not occupied at the time of the earthquake and hence no internal partitions existed. Therefore, it is reasonable to expect that the nonstructural damage would exceed the amount reported if the building had been occupied. The building was constructed in 1970 at an approximate cost of $4 million.

Figures D.5 and D.6 show a typical plan and elevation view of the building. Typical floor construction consists of 4-1/2 inch slab on a 17-inch deep pan-joist system, which spans from girder to girder. Lightweight concrete is used for all floors and girders. Columns are rectangular and tied and regular weight stone aggregate is used.

Besides the referenced study, an estimate of ambient, aftershock and earthquake dynamic response parameters was reported in a paper at the International Conference on Microzonation, see [D.3].

The following conclusions are quoted from Building Report No. 28 [D.1]:

"(1) The building resisted the earthquake largely by inelastic means with local yielding of reinforcement and with cracking and localized spalling of column and girder concrete.

(2) The structural response of the building was non-linear and cannot be well described or modeled by linear elastic dynamic analysis techniques.

(3) Calculated earthquake forces were substantially greater than prescribed code minimums. Calculated story shears were greater than 2.5 times code values, and calculated overturning moments were about 2.0 times code values with $J = 1$.

(4) Architectural damage was related to interstory displacements and consisted largely of cracking, racking, and working of partitions. Some mechanical equipment and building contents were damaged by shaking alone.

(5) Structural damage did occur, but it was limited to cracking and minor spalling of concrete. Yielding of reinforcement in localized areas also occurred." [D.1]

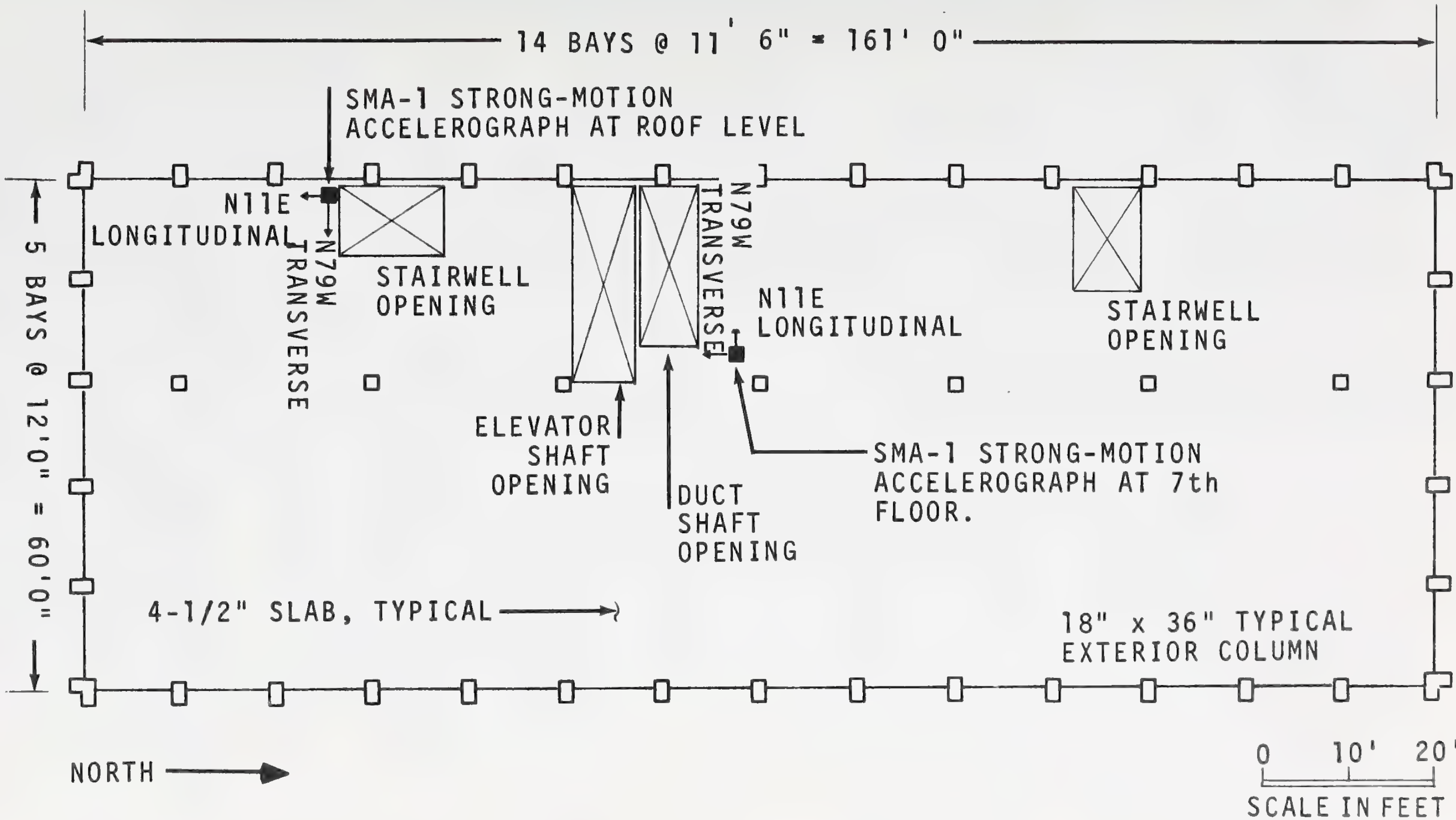


Figure D.5 Typical Floor Plan - Building No. 28

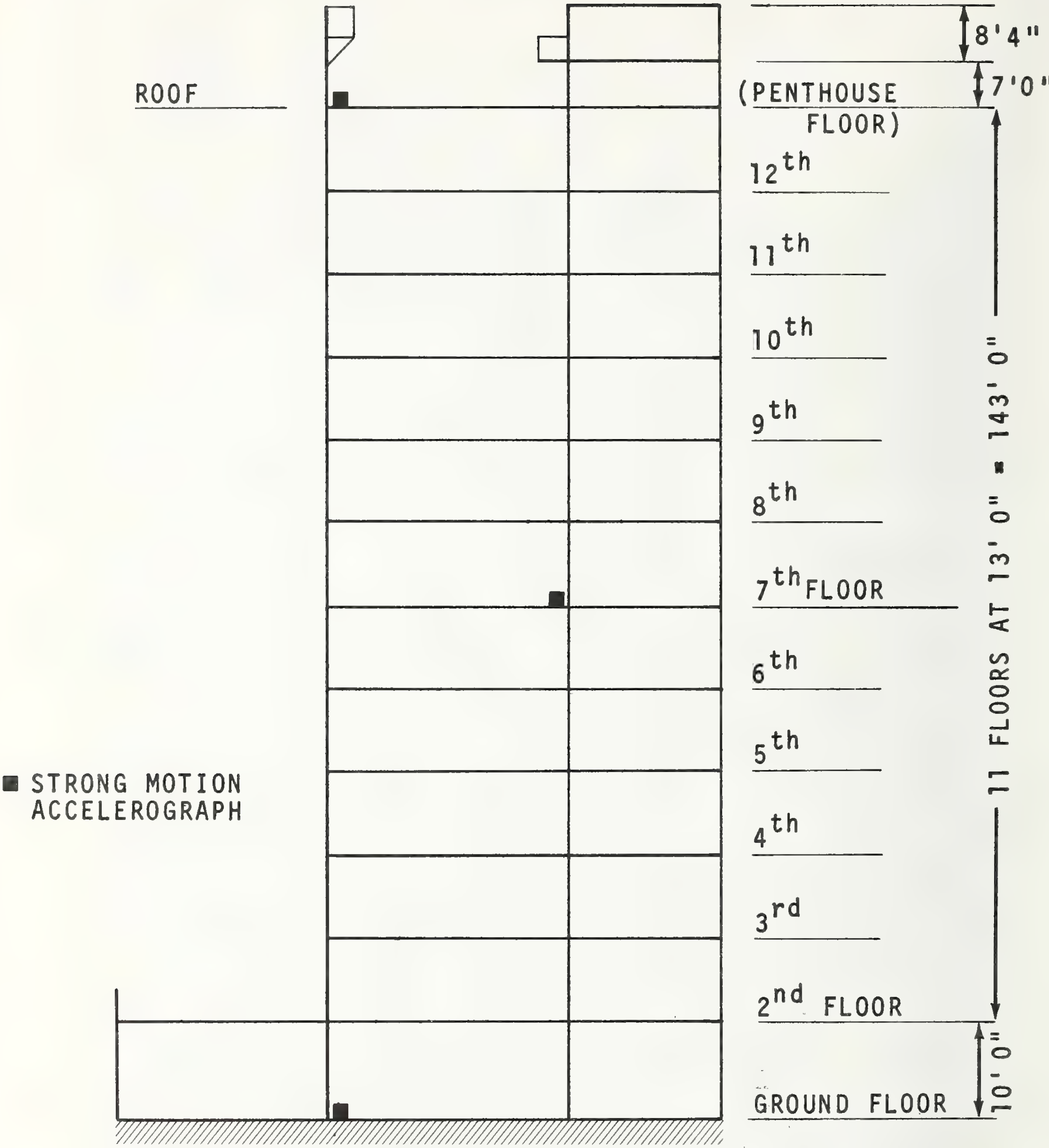


Figure D.6 Typical Transverse Section - Building No. 28

Concrete Frame Building -- Shear Wall

Building Report No. 35 in [D.1] presents the seismic investigation of a high-rise building following the 1971 San Fernando earthquake. Among the instrumented buildings investigated following the San Fernando earthquake and reported on in [D.1] this 14 story building was the only building with a lateral force resisting system composed of shear walls extending throughout the full structural height. This building was constructed in 1966 at an estimated cost of 3 million dollars. The price does not include tenant improvements. Nonstructural damage was estimated at $2,000. Mechanical repair costs on the air conditioning chiller amounted to $30,000. There was no observed structural damage.

Figures D.7 and D.8 show plan and elevation views of the building. The vertical load carrying system consists of reinforced concrete flat slabs supported by columns and bearing walls. These bearing walls also serve as shear walls under lateral loads. All floor slabs are constructed from lightweight concrete. Twelve inch thick shear walls comprise the lateral force resisting system. Stone aggregate concrete weighing 150 pounds per cubic foot was used for the shear walls.

On the basis of an elastic dynamic structural analysis described in [D.1] the following conclusions were made:

"(1) Acceleration response in the North-South direction was 50% greater than East-West.

(2) First mode damping in the North-South direction was estimated to be 5% while the East-West direction was set at 7%.

(3) In the North-South direction maximum building displacements were 300% greater than those produced by current code practice and design values. For East-West displacement, the envelope of dynamic earthquake response was 80% greater than current code design.

(4) The maximum story drift of 1/4 inch occurs between the 8th floor and the roof for the North-South direction.

(5) Comparing the envelope of dynamic maximum shear response to code values, at ground level in the North-South direction, enveloped shears are 70% greater than code shears, while in the East-West direction dynamic values are 30% greater than static code shears.

(6) The general performance of the structure was linear-elastic with only minor lengthening of building periods during the earthquake."[D.1]

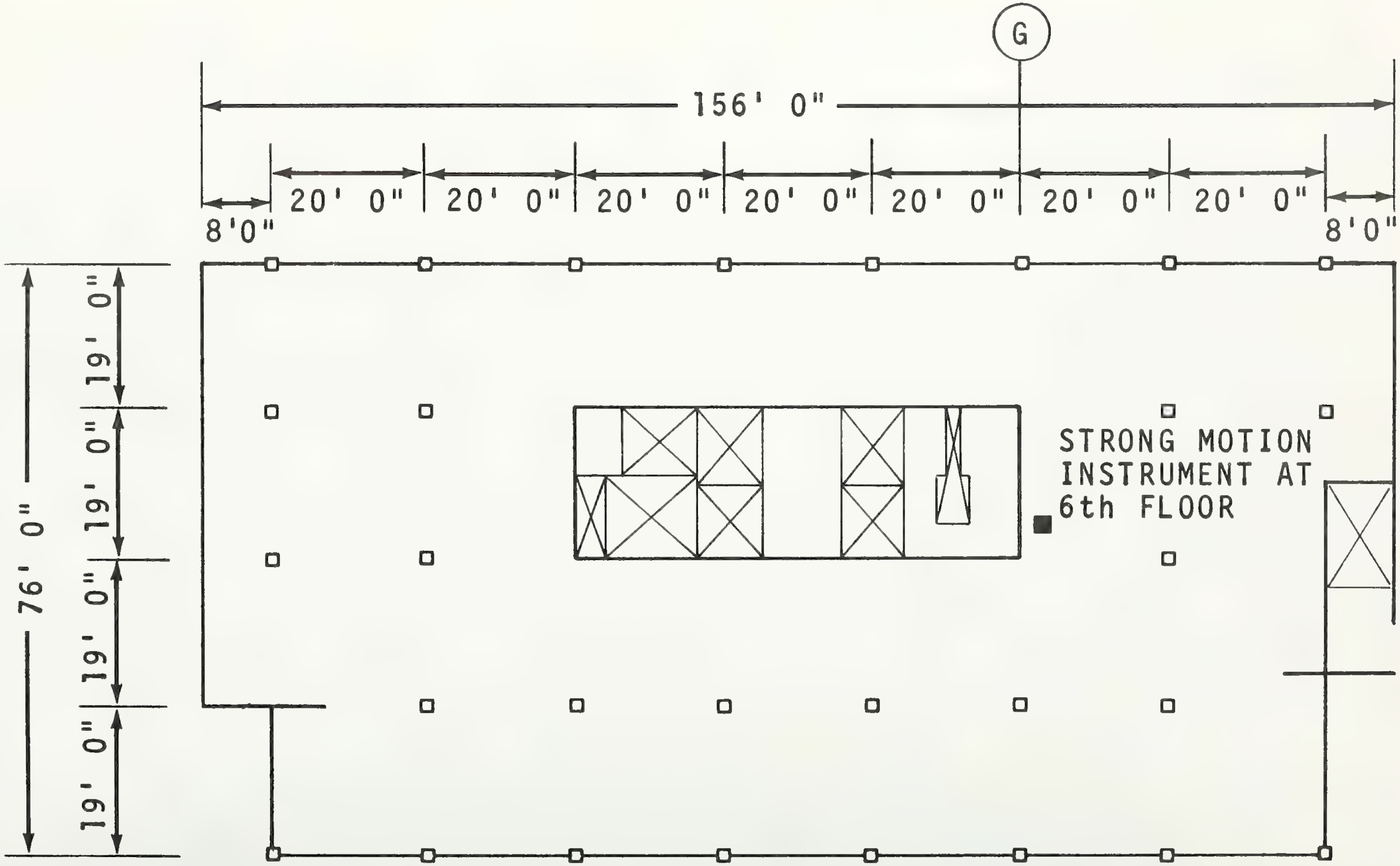


Figure D.7 Typical Floor Plan - Building No. 35

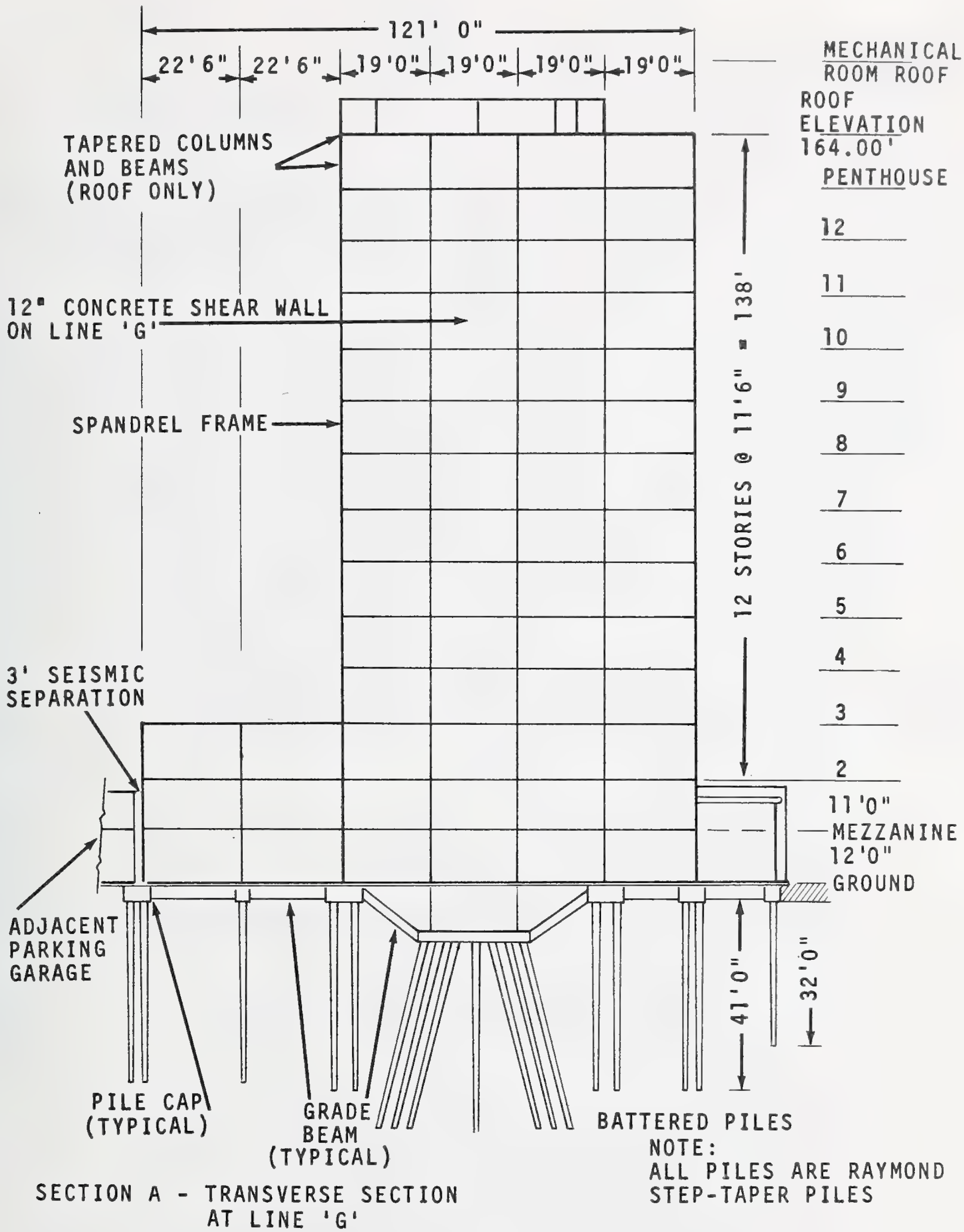


Figure D.8 Transverse Building Section - Building No. 35

Concrete Frame Building -- Infill Walls

Building Report No. 29 in [D.1] was authored by John A. Blume & Associates and describes the earthquake response of a concrete building. The referenced paper conducted a detailed dynamical model of this seven story reinforced concrete structure. Recorded San Fernando basement accelerograms were input to an analytical model and the calculated building response compared with recorded response.

Figures D.9 and D.10 show plan and elevation views of the building. All lateral force resisting columns are regular weight reinforced concrete. Spandrel beams surround the perimeter of the structure and reinforced concrete flat slabs are used -- typically 8 inches thick. Interior partitions are gypsum wallboard on metal studs. One inch thick cement plaster is used for exterior facing at each end of the building. Double 16-gauge metal studs support the cement plaster. All lateral forces are resisted by interior column-slab frames and by exterior column-spandrel beams.

The building construction cost was approximately 1.3 million dollars in 1966 and after the San Fernando earthquake the repair cost to the building was approximately $145,000 (approximately $2,000 was structural). The following conclusions were made in [D.1]:

"(1) During the earthquake, the structure responded at amplitudes that exceeded the elastic limits of a substantial number of girders.

(2) Calculated earthquake forces exceeded prescribed code minimums by a factor of 4 or 5.

(3) Interstory displacements exceeded 1 inch. This accounts for the large amount of nonstructural damage.

(4) On the basis of calculated building response, maximum lateral displacements were from 15 to 20 times prescribed code minimums, but observed structural damage was relatively minor.

(5) Estimates of ductility indicate average ratios of 8 for beams and slabs in the transverse direction and 6 for beams and slabs in the longitudinal direction.

(6) Damping was approximated to be 5% to 10% of critical viscous damping.

(7) Although there was some vertical amplification of vertical ground motion, peak resulting stresses were only approximately 20% of dead and live load stresses."[D.1]

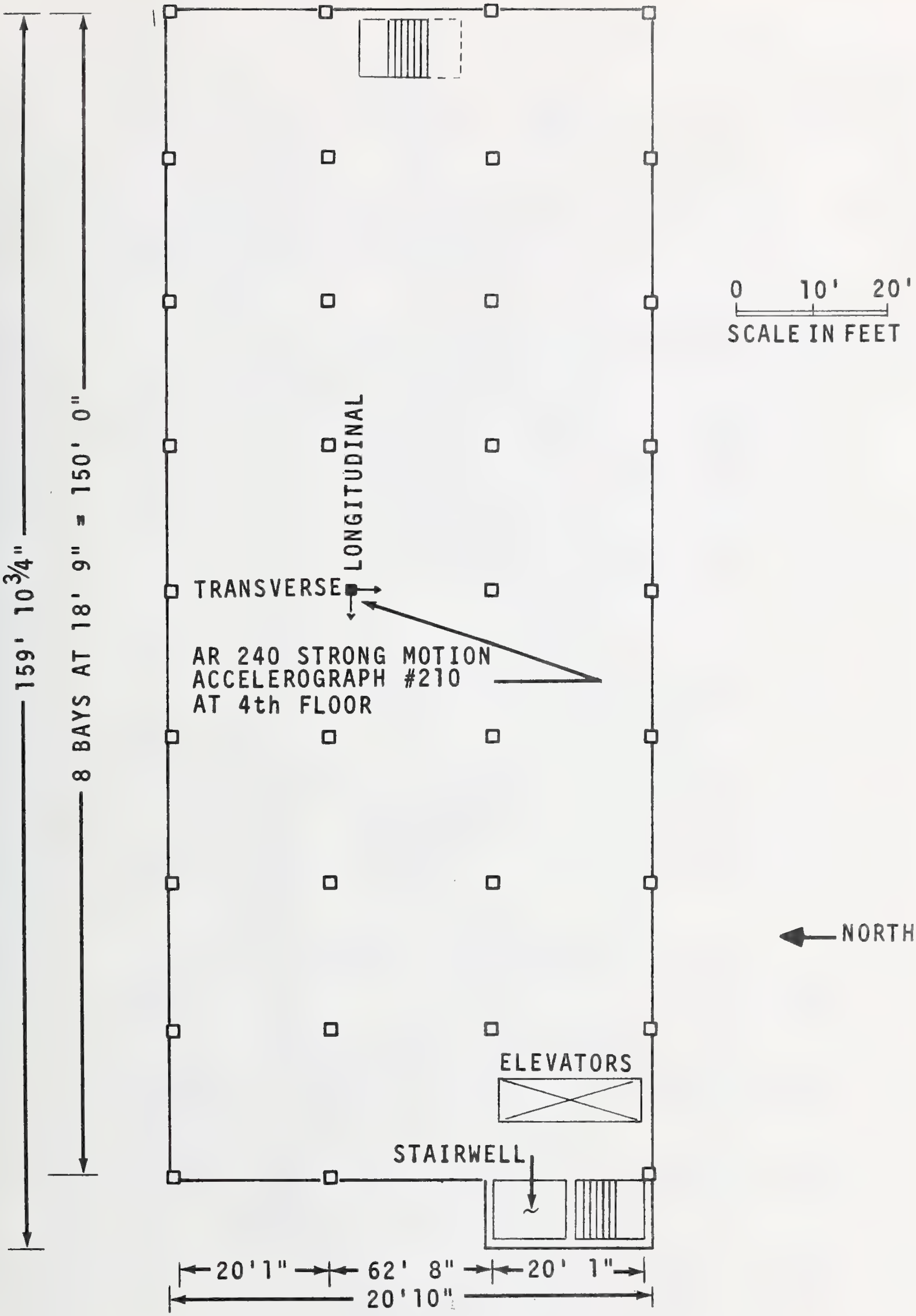


Figure D.9 Typical Floor Framing Plan -- Building No. 29

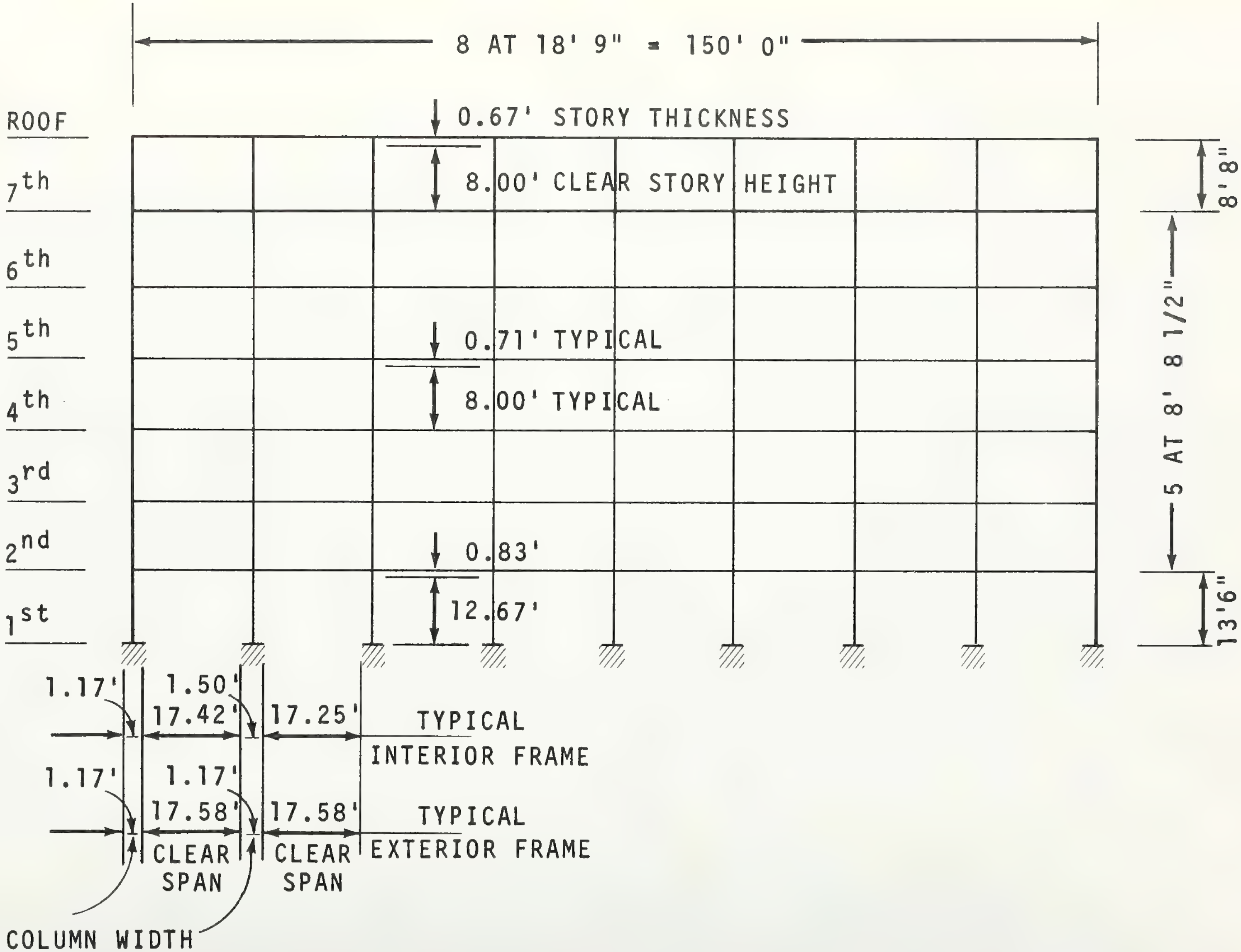


Figure D.10a Typical Longitudinal Frame -- Building No. 29

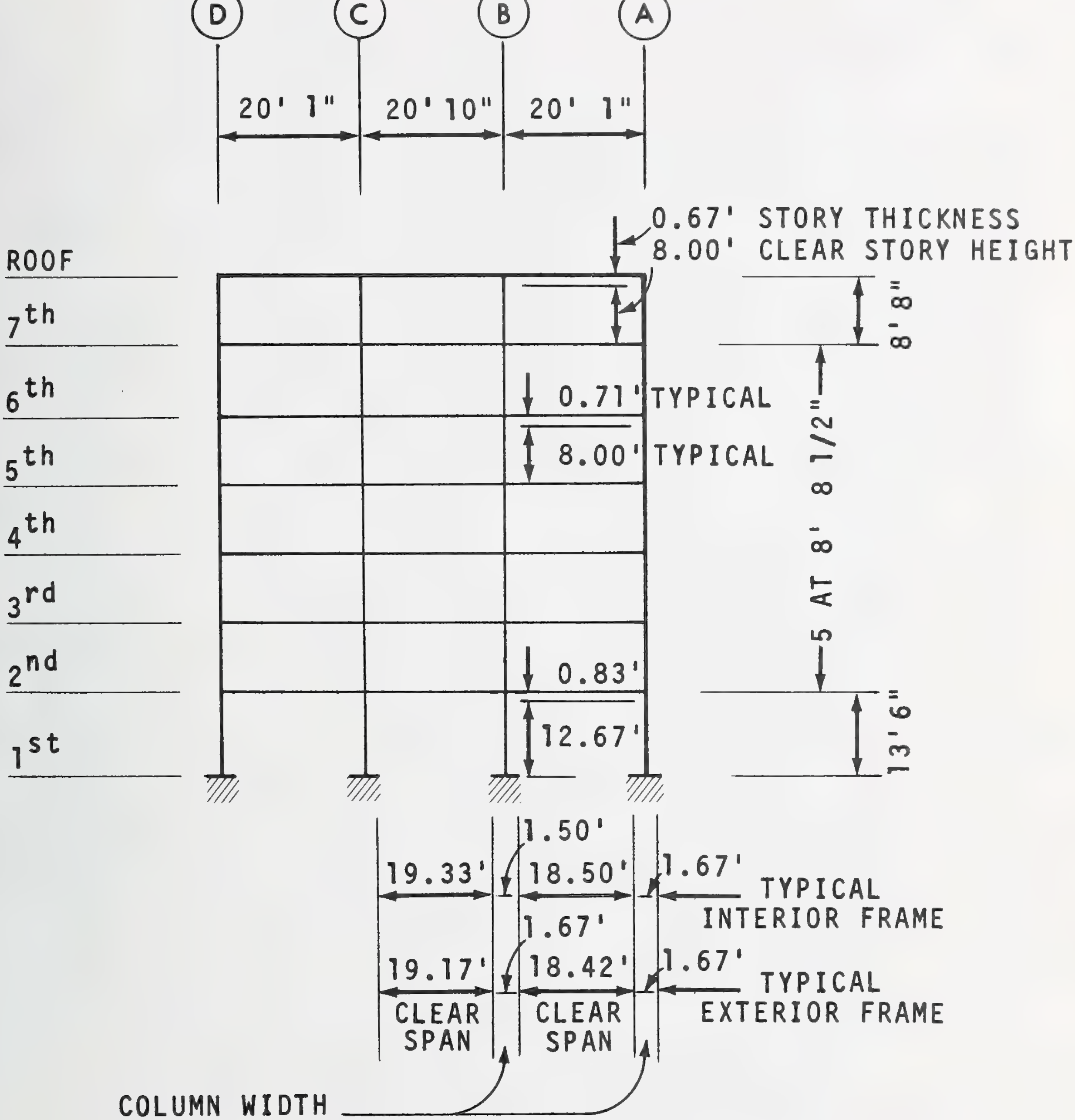


Figure D.10b Typical Transverse Frame -- Building No. 29

Masonry Building -- Load Bearing

Morningside School, Building #1, in the City of San Fernando, California was constructed in 1915. Of the pre-1933 Field Act Schools, Morningside was closest to the center of the 1971 San Fernando earthquake (about 8 miles). A limited description of the building is given [3.51] and [D.4].

> "The building is a two-story "T" shaped concrete bearing wall structure. The original construction had a wood framed gabled roof with heavy slate roofing. Floor framing consisted of wood joists and sheathing. The exterior walls were concrete having an ultimate compressive strength of approximately 900 psi. The partitions were wood studs with plaster on wood strip lath. The building rests on spread foundations. In 1964, the building was reinforced by removing the heavy slate roofing, installing new plywood sheathing in the plane of the second-story ceiling, anchoring the floors and roof to the walls, installing a plywood shear-resisting element in the attic to stabilize the gabled roof framing in the longitudinal direction, and the installation of additional roof supports. New concrete shear-resisting wall panels were added since Title 21 considers concrete with a compressive strength below 1500 psi the same as unreinforced brickwork."

> "The reconstructed building was designed for a 15%g acceleration force, and it came through the earthquake with no structural damage except some overstraining where the gable walls were anchored to the roof framing. Some plaster fell off the 1915 interior partitions. This was a good test of the program for rebuilding old schools to meet the Field Act requirements."

B. TORNADO AND HURRICANE DAMAGE EVALUATION BUILDINGS

Steel Frame Building

There is a lack of good quality damage data for steel frame buildings during strong wind storms. A Texas Tech Report [3.39] describes in some detail the damage to the Great Plains Life Building in Lubbock, Texas during the May 11, 1970 tornado. This report presents a general structural description of the building as well as considerable pertinent and interesting observations.

The building is a 20 story steel frame with a 125 x 56 ft tower plan and a 125 x 75 ft three-story base plan. Of particular importance in the structural dynamic behavior of this building, is the existence of a very stiff north end relative to south, thus causing significant structural torsional eccentricity.

The following quotations from the Texas Tech report indicate the character of the building's damage:

"Damage to the building was classified as severe. All tenants have vacated the building and will not return until extensive repairs are completed. The steel frame sustained permanent deformation which exceeds the tolerances allowed for a structure to be out-of-plum. The top of the frame is deformed 12 in. to the east with respect to the base. The damage to the exterior face brick is such that a completely new exterior cladding will likely be required. On the interior many partition walls have collapsed and the plaster on the walls and ceilings is extensively cracked.

A quick glance at the building immediately after the storm revealed that it had been through quite an ordeal. Twenty-seven percent of all window panes were broken. The most severe glass damage was at the southwest corner of the building where there were large rooms with windows on both the south and west sides. This seems reasonable since the wind was from the southwest. Window glass was broken primarily by missiles. The interior hallway partitions did not collapse, so it was not possible for debris to blow completely through the building.

Beginning at the fourth floor level, the damage at the south end of the building was very severe. Interior partitions, particularly those running in an east-west direction, were cracked by diagonal tension. Between floors five and nine all east-west partitions have moved approximately 1 in. to the east with respect to the floor. In the hallways a bulge occurred at each east-west partition. These partitions were not anchored to the floor and extended up to the suspended plaster ceiling. Where partitions collapsed, it appears that they were first cracked by the racking of the building. Then, having been weakened, they collapsed due to either positive or negative pressure from the storm.

The encasements around the columns, formed by gypsum block and covered with 1 in. of plaster, were severely cracked. These cracks then propagated into the adjoining walls. In some instances, these vertical cracks in the column encasement remained open by as much as 1 in. Since there was a clear space of at least 1 in. between the steel column and the gypsum blocks, the relative column deflection must have been 2 in. or more on a given floor.

With a few exceptions, the aluminum window frames were not damaged by the wind. Glass breakage was inconsistently high for the wind velocities estimated at the lower elevations. This high incidence of glass breakage was attributed to racking of the building frame and to missiles. At the upper elevations the percentage of glass broken was consistent with estimated wind velocities.

It was first thought that the deformation of the frame was elastic and that the frame was prevented from returning to its original straight position by frictional resistance developed in the partitions and walls. The interior partitions, suspended ceiling and the south exterior wall at the fifth and sixth floor were removed. However, no elastic rebound occurred. The frame was indeed permanently deformed.

With the steel skeleton stripped at the fifth and sixth floors, it was possible to take a closer look at the structural frame. The column splices which are located immediately above the fifth floor level were found to be intact. There was no evidence of failure of any rivets. The relative movement of one end of the column with respect to the other end was considerable at this level. The maximum slope observed was 0.375 in. in 24 in. This corresponds to a relative movement of 2.25 in. in the 12 ft story height.

The major bending deformation due to sidesway takes place in the columns rather than the beams (strong beam-weak columns). There is, however, some evidence of yielding in the beams. A check of the column flange with a carpenter's level revealed that the column has a slope of 0.125 in. in 12 in. The column flange is plumb opposite the beam connection, indicating that there is no measurable rotation of the joints.

The location of the service shafts and the solid masonry wall at the north end of the building resulted in a structure which was more flexible at the south end of the building. If the service shaft had been in the center of the building or at both ends, the structure would have sustained much less structural and superficial damage. The lack of stiffness at the south end permitted excessive deformations causing damage to the steel frame and extensive cracking of walls and partitions.

Because the north end of the building is much stiffer than the south, the structure tended to rotate about a vertical axis near the north end of the building. Thus the building deflected in a lateral-torsional mode. Evidence of this mode of deflection is found in the large diagonal cracks in the masonry at the north end of the building. Cracks produced by torsional shear were also found in the stairwell on the lower floors. The extent of the damage due to this mode of response appears to be in the exterior walls and possibly in the elevator shafts."[3.39]

It is evident from the preceding comments that the particular structural framing character of this building lead to significant torsional response. The damage evaluation program used herein does not, as mentioned in section 3.4, enable the modeling of a building's torsional motion. However, the damage based on a two-dimensional building model will be evaluated because of the wind engineering significance of the Great Plains Life Building and also to see if the state-of-the-art two-dimensional wind damage model would have predicted serious damage for this building.

The exact cost of the building and its dollar damage are not detailed in the Texas Tech report. However, it is evident that the damage was very severe and a general reference figure of $1.8 million is cited in the report. Based upon average building costs this dollar loss can be approximately estimated to represent fifty percent of the building's cost.

Concrete Frame Building

In Lubbock, Texas the First National Bank-Pioneer Gas Company Building experienced severe damage during the May 11, 1970 tornado. The cited Texas Tech report [3.39 also describes this 15-story reinforced concrete frame and the damage it experienced. The building was constructed in 1968 and was located near the edge of the extensive destruction zone. It is approximately two blocks from the Great Plains Life Building.

The Texas Tech Report offers the following interesting comparison between the response of the two noted Lubbock buildings:

> "The structural response of the Great Plains Life Building and the First National-Pioneer Building makes an interesting comparison. In the case of the First National-Pioneer Building the structural frame behaved adequately with no damage or excessive deflections. The damage resulted from failure of the exterior cladding. On the other hand, the exterior cladding of the Great Plains Life Building remained essentially intact and the damage was primarily due to racking of the structural frame. Yet the amount of damage to the two buildings in dollars is essentially the same.
>
> The structural integrity of the First National-Pioneer Building was never questioned in the press or by the general public. The Great Plains Life Building, on the other hand, suffered from bad publicity and rumors both prior to and after the tornado. As a result many people in Lubbock today would not enter that building. The First National-Pioneer Building has not experienced the bad psychological response of the general public." [D.5]

The report also offers the following comments relative to the observed damage to the building.

> "Damage to the building is classified as severe; however, it was not necessary to completely vacate the building. Many offices were not disturbed at all; some had only window damage and scattering of contents by the wind, while other offices were virtually destroyed. The private club on the top floor was completely demolished.
>
> Unlike the Great Plains Life Building, the First National-Pioneer Building received no damage to the structural frame. The rigidity of the reinforced concrete frame, due in part to the shape of the building, prevented excessive deformations of the structure. Hence, the damage due to racking of the building was minimal. Yet the cost to repair the First National-Pioneer Building is equal to, if not greater than, the cost to repair the Great Plains Life Building. Cost of repair to First National-Pioneer was reported to be $1.8 million.
>
> Each glass panel on the north and south exterior walls was 49 x 72 in. and had a nominal 13/64 in. thickness. The north leeward face of the building surprisingly suffered 60 percent more broken panes than the south windward face. This unexpected distribution has been attributed to some combination of two factors:
>
> (1) After windward panes broke, interior partition panels, office material, etc., were broken and the debris contributed to breakage on the far wall.
>
> (2) With windward panes out, stagnation pressure on the inside combined with occasional outward pressure on the leeward side generated differentials across leeward plate glass.
>
> However, the correlation between broken panels on the windward and leeward sides by floors was not good."[3.39]

Long Span Roof Structure

The Texas Tech Report [3.39] described in limited detail the damage done to the Tech Village Apartments by the Lubbock storm of May 11, 1970. The Tech Apartments is a complex of seven identically constructed buildings, see figure D.11. Each building in the complex is two story and rectangular in plan with loadbearing concrete block walls and metal deck roofing. The size of the buildings ranges from 14,000 to 21,000 square feet.

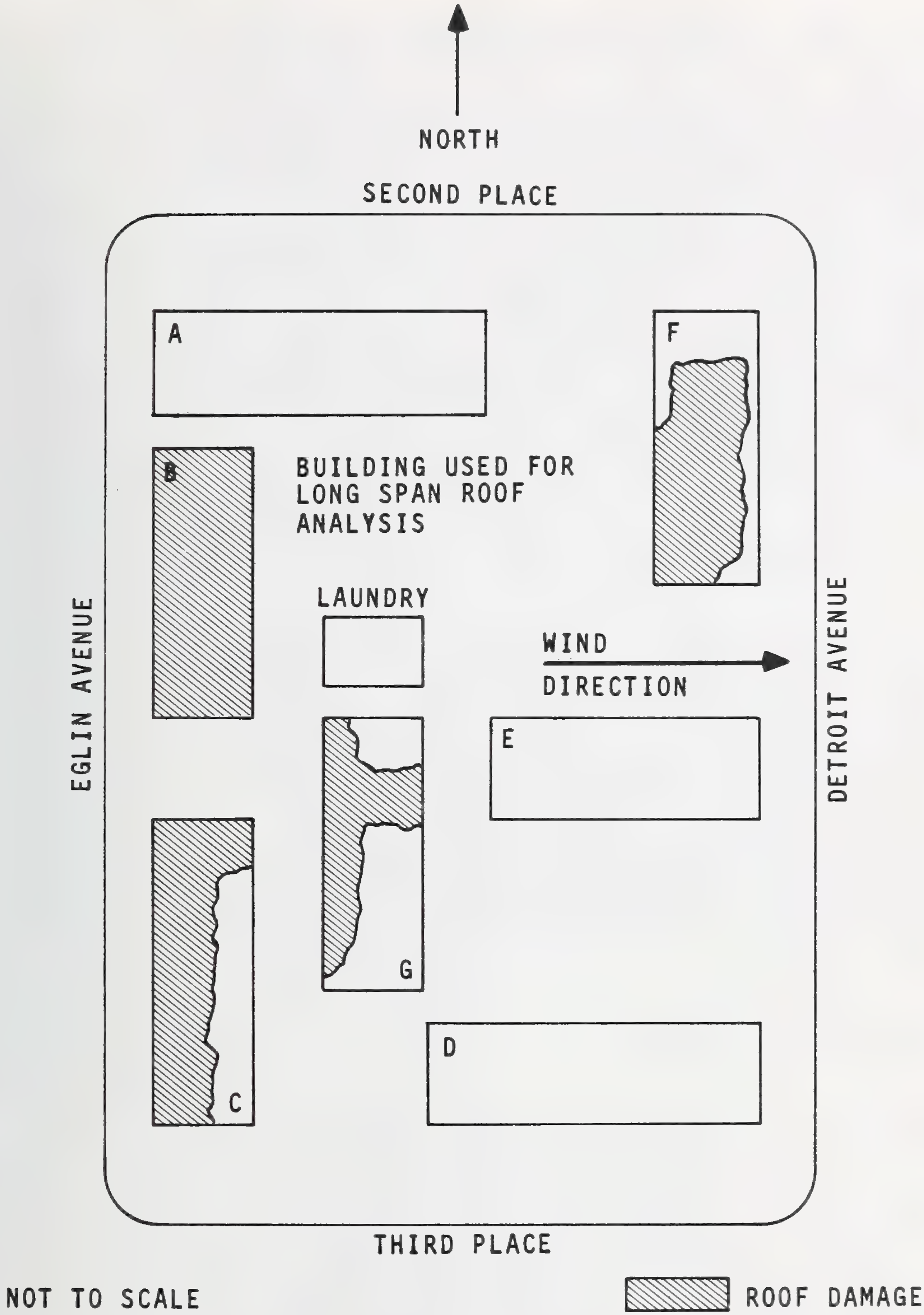


Figure D.11 Tech Village Apartment Complex

"The exterior walls are constructed of concrete block. At the short end of the building the 12-in thick walls are made of 4-in brick backed by 8-in concrete block. A double concrete block wall runs in the longitudinal direction and divides each building in half. All interior partitions are concrete block and are load-bearing. The exterior walls and those partitions which separate individual apartments have bond beams at roof level. The bond beams are reinforced with two no. 8 bars. The second floor slab is 4-in thick concrete resting on load-bearing masonry walls. The roof is made of light weight metal deck with fiber board insulation and built-up roof. The metal deck is spot welded to a small steel angle embedded inthe concrete of the bond beams. A 5 ft. wide exterior corridor gives access to the second floor apartments. The roof extends out to form a canopy for the corridor. The roof overhand and the second floor walkway are supported by 3 in. diameter pipe columns spaced 12-ft on centers. The overhand at roof level is supported by 6-in channels welded to the pipe columns and attached to small angles anchored to the bond beam at the exterior walls. The overhand at roof level is an integral part of the roof system."[3.39]

Damage to the complex is rated as severe. Again, quoting from the cited report:

"The four buildings in this complex which sustained structural damage were the ones with their longitudininal axes oriented in the north-south direction. The major damage was the stripping off of the roof. Apparently the force of the wind striking the roof canopy on the west side of the buildings dislodged the metal deck from the top of the walls and peeled back the roof. The steel angles anchored in the bond beams pulled out, but they served to tie the metal deck together in large pieces; thus allowing the force of the wind to strip metal deck from the building. Some of the exterior walls collapsed, but most interior partitions at the second floor level remained intact. First floor apartments suffered very little structural damage."[3.39]

D.6 DAMAGE EVALUATIONS USING THE DETAILED EVALUATION METHOD

A. General Comments

This section presents damage evaluation estimates for earthquake, tornado and hurricane natural disasters. The buildings noted in section D.5 have been used in this evaluation. As noted in section 3.4 there exist many input parameters which require professional engineering judgment. Examples of these include: (1) building quality factor, (2) ductility to failure of structural and nonstructural members, (3) drift to yield, etc., This necessity to input professional judgment means that it is extremely likely that two independent engineers will when using the detailed computer program obtain different damage estimates. To assess the sensitivity which the different decisions have upon the final evaluation is beyond the scope of this study, however, the following example problems certainly provide some engineering insight into this area.

B. Earthquake Damage Evaluations

The results of damage evaluations conducted on each of the buildings noted in section D.5a are summarized. The earthquake damage evaluations are based upon magnitude and epicentral distances for the actual San Fernando earthquake. From the nature of the developed computer program, there exists a multitude of possible parameter permutations. In this section, the values of the parameters used to perform the evaluations are based upon data presented in section 3.4 and are realistic for the building under consideration.

For each building which is modeled using the empirical building model the estimated building period was obtained from [3.50] and reflects the observed San Fernando earthquake building period. When actual seismic response data does not exist the following two alternatives can be used: (1) use ambient building periods scaled up in magnitude by a value believed to be appropriate for the earthquake size and epicentral distance under consideration (e.g., usually 1.33 to 1.5) or (2) use existing formulas of the type described in section 3.4.

Table D.2 summarizes for each of the noted buildings the selected values of several of the important input parameters. The damage experienced by each of the buildings is estimated in two damage evaluation procedures. Option 1 in table D.3 is a summation of the floor-by-floor damage. All damage estimates are based upon the methodology described in section 3.4. Option 2 presents damage estimates which are based upon one engineer's professional experience. As the computer program outputs MMI values for each building floor it is only necessary for the engineer to average the MMI from all building floors to obtain an average building MMI.

Table D.2 SAN FERNANDO EARTHQUAKE EXAMPLES

Building	Fundamental Period (Sec)	Interstory Drift to Yield (in/in)	Quality Factor	Frame Ductility to Failure	Wall Ductility to Failure	Model Character-ization
Building No. 32 (Steel-moment frame)	E-W = 3.28 N-S = 3.34	.013	3.0	18.0	7.0	Empirical
Building No. 37 (Steel-braced frame)	N-S = 3.43 E-W = 3.41	.013	3.0	18.0	7.0	Empirical
Building No. 28 (Concrete-moment frame)	N-S = 2.38 E-W = 2.94	.005	3.0	8.0	7.0	Empirical
Building No. 35 (Concrete-shearwall)	N-S = 0.98 E-W = 1.02	.003	2.25	4.0	4.0	Story Stiffness
Building No. 29 (Concrete-infill wall)	N-S = 1.49 E-W = 1.26	.005	3.0	8.0	7.0	Empirical
Morningside School	Long = 0.10 Trans = 0.15	.001	1.2(Top) 1.0 (Bottom)	1.5	1.5	Empirical

Then using the average building MMI and a table of the type shown in table D.3, one can estimate the percent nonstructural, structural and total damage.

It is noted that Option 2 is presented for the purpose of indicating how one engineer may use the output from the program to estimate damage. That is, if one wishes to use a relationship between damage and building MMI based upon professional experience, one may create a damage estimate. While such individualism is often commendable, it may also be unwise because the formulas used in Option 1 were obtained from a study of considerable historical data.

The correlation between the observed and predicted damage estimates is good. It is noted that the damage estimates reflect the results of only one computer run on each building and are not the results obtained after several iterations aimed at producing an estimate that correlates almost exactly with observed damage. Therefore, the user can expect the same level of accuracy as indicated by the results in table D.4.

C. Tornado Damage Evaluations

The structural and nonstructural damage data available for a tornado natural disaster are very limited. This section performs a damage evaluation of the three buildings noted in section D.5b. These estimates are compared with values cited in [3.39].

Table D.5 presents a summary of the values of the structural input parameters used in this study. Tornado maximum wind speed was set at 200 miles per hour. Table D.6 summarizes the computed and observed damage for each of the three buildings.

D. Hurricane Damage Evaluations

The same buildings noted in section D.5b and table D.6 were also used for the estimation of damage due to a hypothetical hurricane. The hurricane is selected to have a maximum wind speed of 120 miles per hour at a height of 30 feet. All building parameter values are the same as used in the Tornado example, see table D.5.

Since the hurricane evaluation utilizes a hypothetical example there is no observed damage data. Table D.7 presents the predicted percent damage for each building.

Table D.3 DAMAGE ESTIMATES FOR SAN FERNANDO EARTHQUAKE - FEBRUARY 9, 1971

BUILDING	Percent Structural Damage (Av.)			Percent Nonstructural Damage (Av.)			Total % Building Damage (Av.)*			Average Modified Mercalli Intensity For Building
	Computed Option 1	Computed Option 2	Observed Ref[E.1]	Computed Option 1	Computed Option 2	Observed Ref[E.1]	Computed Option 1	Computed Option 2	Observed Ref[E.1]	
Building No. 32	N-S=0.00 E-W=0.00	0.02	0.00	N-S=0.35 E-W=0.36	3.01	0.08	0.27	2.78	0.08	N-S=7.25 E-W=7.27
Building No. 37	N-S=0.00 E-W=0.00	0.00	0.00	N-S=0.16 E-W=0.16	0.84	0.06	0.12	0.84	0.06	N-S=6.59 E-W=6.59
Building No.28	N-S=0.00 E-W=0.00	0.17	0.03	N-S=0.53 E-W=0.38	5.01	0.08	0.34	4.28	1.1	N-S=7.58 E-W=7.30
Building No.35	N-S=0.10 E-W=0.20	0.33	0.0	N-S=2.5 E-W=2.0	8.5	1.00**	1.70	6.4	1.00**	N-S=8.1 E-W=8.2
Building No. 29	N-S=0.28 E-W=0.41	3.18	0.1	N-S=2.03 E-W=2.13	17.77	10.9	1.73	11.73	11.0	N-S=8.74 E-W=8.74
Morning-side School	Long=0.0 Trans=0.0	2.6	Ref[E.4] Nominal	Long=12.5 Trans=31.5	19.3	Ref[E.4] Most of the interior plaster on wood lath was loosened. All the lath and plaster has been removed and replaced with drywall.	16.5	15.1	Ref[E.4]	Long=7.8 Trans=8.3

*Structural assumed to be 25% and nonstructural 75% of total

**Includes repair cost to air conditioning chiller.

Table D.4 S. B. BARNS & C. PINKHAM'S MEAN DAMAGE ESTIMATES FOR VARIOUS QUALITY FACTORS, Q, SPECIFIED IN TERMS OF SEISMIC DESIGN ZONE

CONCRETE SHEAR WALL

Quality Factor, Q*

MMI	a (g)	V (in/sec)	Non Structural (NST)				Structural (ST)				Total			
			Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q=3	Q=4
6	.060	2.03	.03	.028	.013	.025	0	0	0	0	.028	.029	.027	.043
7	.115	4.71	3.13	1.83	1.24	.33	.013	0	0	0	3.02	1.77	1.09	.853
8	.223	10.9	19.3	11.0	7.70	3.2	2.6	.86	.22	.027	12.67	7.9	5.11	2.69
9	.431	25.4	56.6	27.2	12.9	6.83	26.6	6.77	.96	.268	35.67	17.5	7.81	5.35

CONCRETE MOMENT FRAME

Quality Factor, Q

MMI	a (g)	V (in/sec)	Non Structural (NST)				Structural (ST)				Total			
			Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q-3	Q=4
6	.060	2.03	.05	.093	.064	.063	0	0	0	0	.065	.1	.063	.06
7	.115	4.71	4.25	3.37	3.02	2.23	.037	.012	.012	0	3.93	3.4	3.07	2.21
8	.223	10.9	17.73	15.2	10.27	6.48	3.6	1.66	.57	.17	15.37	10.27	7.48	5.3
9	.431	25.4	52	32.37	23.93	17.93	25.47	9.63	5.32	2.13	34.07	27.93	15.22	11.72

*Q=1 (Z=0.25), Q=2 (Z = 0.50), Q=3 (Z = 1.50), Q=4 (Z = 2.00),
Z = seismicity coefficient of zone in which building is located

Table D.4 S. B. BARNES & C. PINKHAM'S MEAN DAMAGE ESTIMATES FOR VARIOUS QUALITY FACTORS (Continued)

STEEL MOMENT FRAME

Quality Factor, Q

MMI	a (g)	V (in/sec)	Non Structural (NST)				Structural (ST)				Total			
			Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q=3	Q=4
6	.060	2.03	.109	.058	.052	.046	0	0	0	0	.109	.058	.051	.046
7	.115	4.71	3.47	2.9	2.23	1.61	.01	.003	0	0	3.32	2.88	2.23	1.61
8	.223	10.9	12.17	9.47	6.63	5.5	.87	.404	.121	.111	8.49	6.87	5.35	4.57
9	.431	25.4	32.33	25.17	14.47	11.33	9.4	5.6	1.75	.877	20.85	16.17	9.57	7.18

STEEL BRACED FRAME

Quality Factor Q

MMI	a (g)	V (in/sec)	Non Structural (NST)				Structural (ST)				Total			
			Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q=3	Q=4	Q=1	Q=2	Q=3	Q=4
6	.060	2.03	.027	.025	.027	.026	0	0	0	0	.027	.027	.0265	.026
7	.115	4.71	3.53	2.21	1.41	.483	.013	0	0	0	3.38	2.26	1.39	.48
8	.223	10.9	21.67	12.87	7.67	4.18	3.66	1.02	.282	.031	12.42	9.22	5.93	3.78
9	.431	25.4	58.67	43.17	21.6	9.18	28.67	16.67	4.22	.339	38.67	27.67	14.53	6.95

Table D.5 TORNADO AND HURRICANE EXAMPLES

BUILDING	Fundamental Period (Sec)	Interstory Drift to Yield (in/in)
Great Plains Life (Steel)	2.0	.005
First National Bank-Pioneer Gas Company (Concrete)	2.0	.005
Tech Village Apartments (Long span roof)	0.1	.002

Table D.6 TORNADO DAMAGE EVALUATION

BUILDING	Percent Structural Damage		Percent Nonstructural Damage		Total % Building Damage	
	Computed	Observed Ref.[D.5]	Computed	Observed Ref.[D.5]	Computed	Observed Ref.[D.5]
Great Plains Life (Steel)	36.4	----	Partitions: 44.5 Glass: 98.4	Partitions: Many Glass: 27	62.7	50
First National Bank-Pioneer Gas Company (Concrete)	50.5	None	Partitions: 50.3 Glass: 37.0	Partitions: --- Glass: ---	45.4	35
Tech Village Apartments (Long span roof)	Roof Off	Roof Off	Partitions: 3.7 Glass: 94	Partitions: No data given Glass: No data given	Roof Off	Roof Off

Table D.7 HURRICANE DAMAGE EVALUATION

BUILDING	Percent Structural Damage	Percent Nonstructural Damage	Total % Building Damage
Great Plains Life (Steel)	0.0	Partitions: 1.0% Glass: 3.4%	1.7
First National Bank-Pioneer Gas Company (Concrete)	1.25	Partitions: 9.0% Glass: 18.2%	10.7
Tech Village Apartments (Long span roof)	0.05 (Roof On)	Partitions: 2.5% Glass: 1.4%	1.5

APPENDIX E

DETAILED ANALYTICAL EVALUATION METHOD - COMPUTER PROGRAM USERS MANUAL

This appendix contains the User's Manual for the Detailed Analytical Method computer program. The manual is presented as a self-contained document so as to provide the user with a package which may be more conveniently used in the evaluation process. The manual represents the combined efforts of T. K. Hasselman, Richard W. White and Gregg Brandow.

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1.0 PROGRAM DESCRIPTION

The computer program described in this User's Manual provides the basic tools for evaluating potential damage to buildings due to earthquake, wind and tornado. Environmental data are provided along with the program describing the seismic and wind activity for the entire continental United States, Alaska and Hawaii. Historically based tornado activity for the continental United States is included. With these data, the program will compute, in a probabilistic sense, the specific environment of any given building site in the country. Alternatively, the user may choose to input any of these loads directly. For example, an earthquake of Richter magnitude 6.5 at a distance of 10 miles may be input by specifying only those two parameters. The user may also bypass the earthquake loading portion of the program and input directly a ground particle velocity spectra for the site. Damage predictions are made on the basis of the building's response to the appropriate loading conditions. Structural models of varying complexity can be generated depending on the availability of structural data and the level of effort selected for a particular task. Damageability data characterizing the capacity of the building to resist failure must be input by the user. Guidelines are provided in Section 3.4 of the main text of this report. Algorithms for computing damage are based on the assumption that percent damage varies continuously with key response parameters. These key parameters have been selected and are incorporated in the program. The forms of damage distribution curves as functions of response are also built into the program. The user may choose the parameters of these functions in accordance with prepared guidelines and exercise his judgement according to the application at hand.

The computer program is currently operational on the UNIVAC 1108 computer at the National Bureau of Standards and the CDC 3600 computer at the Defense Civil Preparedness agency. Special requirements for the input data for the CDC 3600 are provided at the end of this appendix.

A more detailed discussion of the program is given in the paragraphs which follow. Flow diagrams are included at the end of

this section which illustrate the top and secondary levels of program organization. Detailed input preparation is explained in Section 2.0 and a discussion of the printed output is included in Section 3.0.

The entire program is organized in modular form. This tends to provide a simple framework for understanding the program and offers flexibility for subsequent updating anticipated as the result of user experience. Considerable effort has been made to maintain clean interfaces among the different modules to facilitate maintenance and avoid repetitive operations and unnecessary data handling. The overall flow of information within the program is shown in flow Diagram 1. The four major parts of the program include:

1) the generation of site loads
2) the generation of a structural model
3) computation of response, and
4) assessment of damage.

Subroutine LØADS constitutes the first part, STRUCT the second, DYNAMC, STATIC and LSRØØF the third, and DAMAG the fourth. As shown in the flow diagram, operations proceed in that order. Options are provided to allow consideration of the three environmental hazards singly or in combination.

Damage to longspan roofs is treated independently of structure related damage as discussed in Section 1.3 of this Appendix and Chapter 3 (Section 3.4 I) of the main text.

1.1 Loads

The LØADS subroutine, Flow Diagram 2, calls four other subroutines, depending on the hazard options selected. The options are:

NHAZ(1) = 0: bypass earthquake loads
$\neq$ 0: generate earthquake loads

NHAZ(2) = 0: bypass wind loads
$\neq$ 0: generate wind loads

NHAZ(3) = 0: bypass tornado loads
$\neq$ 0: generate tornado loads

Site loads for earthquake are defined by a ground site response spectrum. This response spectrum reflects an amplification of the hard-rock spectrum for the site, which is frequency dependent. The hard-rock spectrum is generated in Subroutine SEISMC. This is done in either of two ways (See Section 2.1.1.1 and Chapter 3 of the main text). If the risk option is selected, LRISK $\neq$ 0, the user must input seismicity data from the Seismic Map provided with the program. By further specifying either a return period or building life and probability of non-occurrence, a risk earthquake defined by its Richter magnitude EM is computed. If LRISK = 0, the risk option is bypassed and the user must input a magnitude EM and hypocentral distance RBAR. In either case, hard-rock acceleration, velocity and displacement characteristics are computed and transmitted to Subroutine SØILØD.

A soil model is generated in SØILØD as a basis for determining soil amplification of the hard-rock ground motion. Four basic

modeling options are provided ranging from a complex model requiring detailed soils data to a simple model requiring only standard geological soil characterization (See Section 2.1.1.2 and Section 3.4 of the main text. A dynamic amplification factor $(DAF)_s$ for the soil is computed as a function of frequency (or period). A hard-rock spectrum is generated from the acceleration, velocity and displacement characteristics computed in SEISMIC and then multiplied by $(DAF)_s$ to generate the ground site spectrum. The procedure for directly inputting a ground particle velocity spectra is discussed in Section 2.1.1.3.

If NHAZ(2) $\neq$ 0, a wind velocity is generated for the specified site (see Section 2.1.2). If ITEST = 1, a statistical regression analysis is used to compute a mean wind velocity given either a return period or building life and probability of non-occurrence. A standard deviation is also computed and may be used to establish some degree of confidence in the wind velocity selected for analysis. If ITEST = 2, the user must input a wind velocity for analysis. As in the case of earthquakes, local site conditions modify the wind velocity which is determined on the basis of historical data. For example, free-field wind velocities in large cities are attenuated by the presence of buildings, whereas, on an open prairie, the attenuation is comparatively small. Thus, in figuring the wind load on a building, surface conditions are accounted for by specifying the parameter ISITE as described in Section 2.1.2.

If NHAZ(3) $\neq$ 0, the probability of being hit by a tornado is computed from map data giving the mean annual frequency of tornados. In addition, the user may specify a tornado wind velocity by setting ITØR $\neq$ 0 and inputting a velocity VT as explained in Section 2.1.3. In this case, the static response of the building will be computed and damage assessments made.

1.2 Structural Model

Subroutine STRUCT (Flow Diagram 3) accepts structural modeling data and generates a model of the structure for subsequent response analysis. Dynamic characteristics are either input or computed by this subroutine. Three modeling options are provided:

NMØD = 1: Detailed frame model

NMØD = 2: Story stiffness model

NMØD = 3: Empirical model

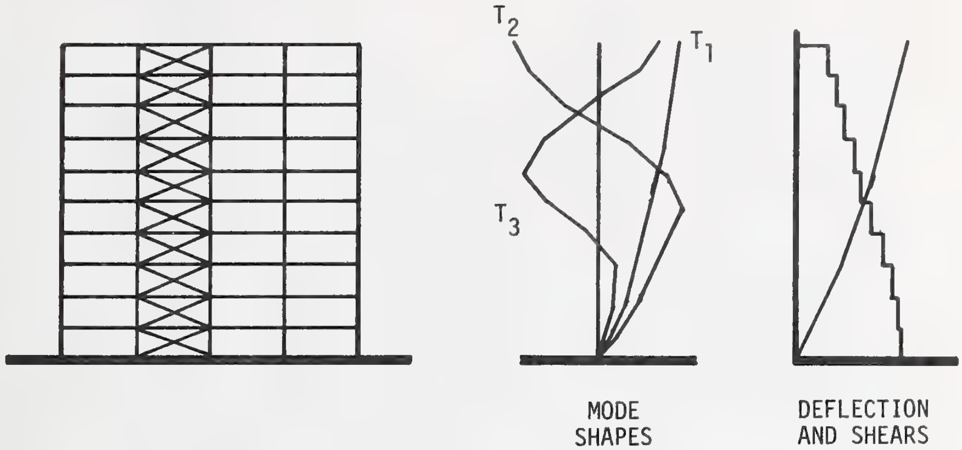
Sketches of these modeling configurations are included in Figures 1 through 3 to illustrate the scope of model complexity.

If the user selects NMØD = 1, STRUCT calls STIFF1 which is used to generate a detailed stiffness matrix for the structure (See Section 2.2.1). The stiffness matrix is constructed frame by frame, story by story, from top to bottom. Coordinate numbering conventions are shown in Figure 4. As shown in Flow Diagram 4, the user must first input a value for NFRMS which specifies the number of frames to be used in the model. Each frame is parallel to the direction of motion in a vertical plane. Stiffness and mass contributions from each frame are superposed in formulating the two-dimensional model of a building. The user may choose between two frame modeling options:

NØPT = 1: Steel frame model (SFRAME)

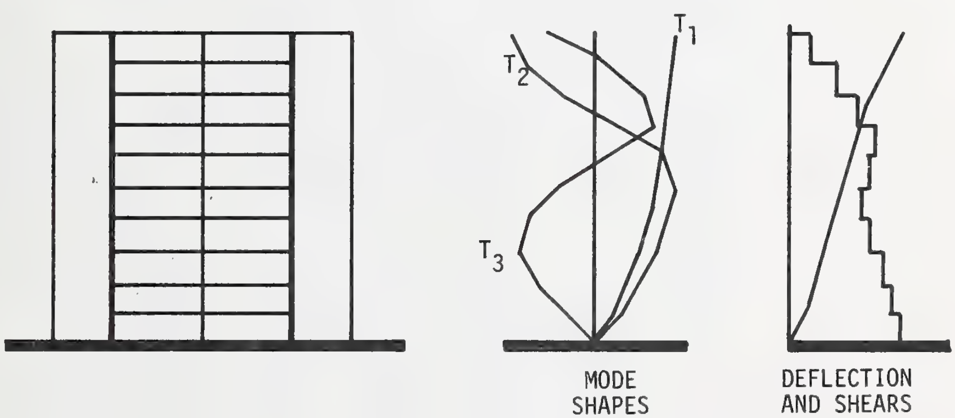
NØPT = 2: General frame model (GFRAME)

The steel frame model is most convenient to use for steel frame structures because standard framing members may be



NØPT = 1

(Steel Frame Model)



NØPT = 2

(General Frame Model)

Figure 1. NMOD = 1 Detailed Frame Model Options

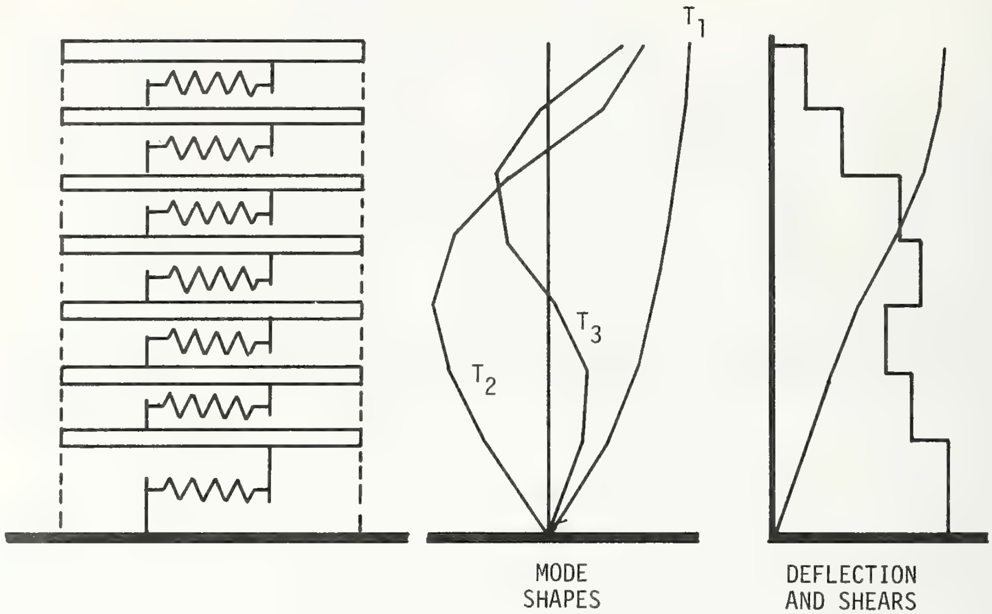


Figure 2. NMOD = 2 Story Stiffness Model

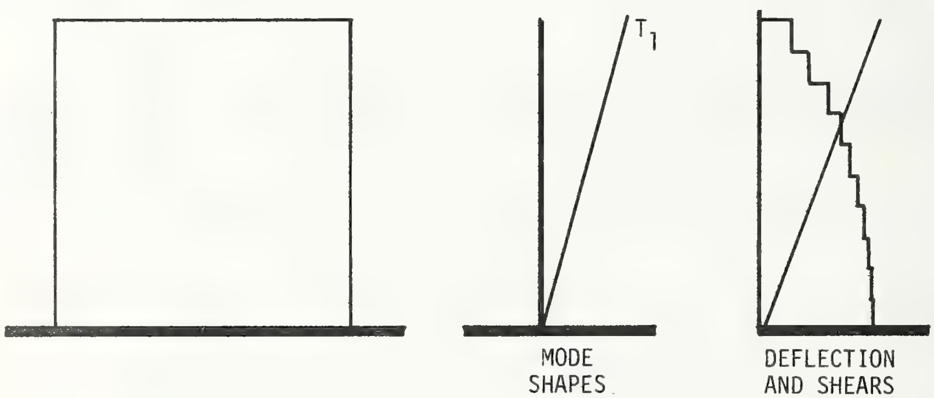


Figure 3. NMOD = 3 Empirical Model

REMARKS:
1. BEAMS, COLUMNS, AND JOINT LOCATIONS AT EACH FLOOR ARE NUMBERED FROM LEFT TO RIGHT, STARTING WITH 1.
2. STORIES ARE NUMBERED FROM TOP TO BOTTOM.

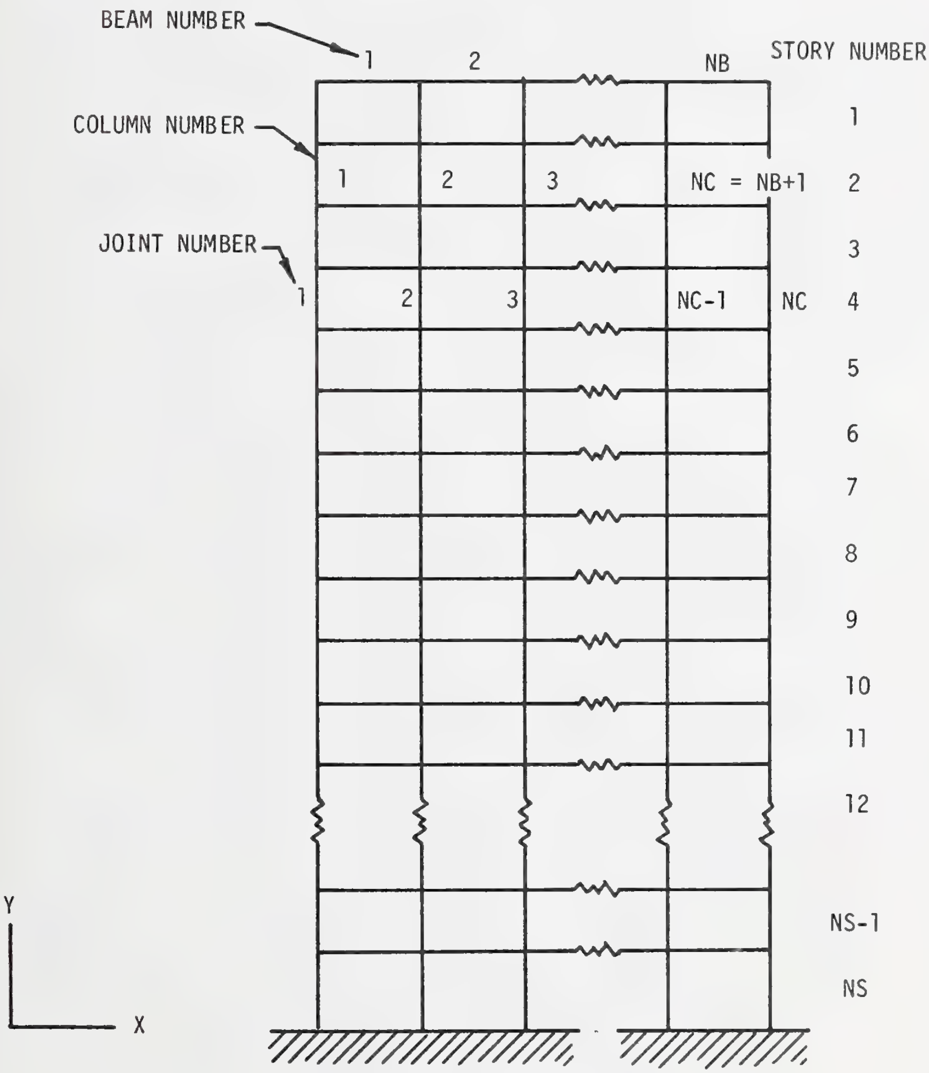


Figure 4. Numbering Conventions

specified by code rather than having to enter detailed section properties. In addition, it offers the capability for including non-rigid joints. The general frame model is intended primarily for concrete frame and shearwall type structures, although it could be used for steel frame structures as well. This option must be used to model frames with shearwalls since NØPT = 1 offers no shearwall modeling capability. (See Section 2.2.1).

Although it is not shown explicitly in Flow Diagram 4, SFRAME or GFRAME, CØNDEN and FRMASS are called once for each story of the model. CØNDEN operate on the detailed stiffness matrix generated for the current story and condenses it into a reduced stiffness matrix corresponding to floor translations for the current story and all of those above it. If no dead load for framing is to be included in the final mass matrix, the user may set NDLC = 1 and FRMASS, the subroutine which lumps framing mass at each floor, is bypassed.

If NFRMS >1, stiffness matrices for additional frames are generated and superposed, i.e. the frames act in a parallel configuration. NØPT may be reset so that a mixture of SFRAME and GFRAME models can be combined. When the frame counter reaches NFRMS, control is returned to STRUCT.

If the user specifies NMØD = 2, STRUCT calls STIFF2 which reads story stiffness and story height data as described in Section 2.2.2. As with NMØD = 1, an NS x NS stiffness matrix is created.

Floor mass is added to framing mass (if any) by calling subroutine FLMASS. This subroutine reads floor weights in KIPS, converts to mass and adds them to a mass vector, which, in the case of NMØD = 1, may contain framing mass already. The lumped

mass model is shown in Figure 5. After forming the total mass vector for either NMØD = 1 or 2, subroutine EIGENS is called to compute modal deflections and frequencies.

If NMØD = 3, STIFF3 is called and an empirical model is generated. A fundamental period and story heights are read as discussed in Section 2.2.3. A straight-line mode shape is assumed to compute deflections. FLMASS is called to read in floor weights but EIGENS is, of course, bypassed.

1.3 Response

The site loads generated in LØADS and the structural characteristics generated in STRUCT are used in this part of the program to determine structural response to the site environments. Response computations are made in DYNAMC for earthquake loads, in STATIC for wind and tornado loads, and in LSRØØF for uplift due to wind. Ponding loads are also computed in LSRØØF.

The response of a building to earthquake ground motion is evaluated by determining the peak modal response in each of the modes (a maximum of six is considered), and combining their contributions to the total response in some fashion.

Inputs to DYNAMC are explained in Section 2.2.3 and include a damping code, a ductility code, a modal combination code and story drift-to-yield used to compute an effective ductility μ for the building. Since damping is defined as a function

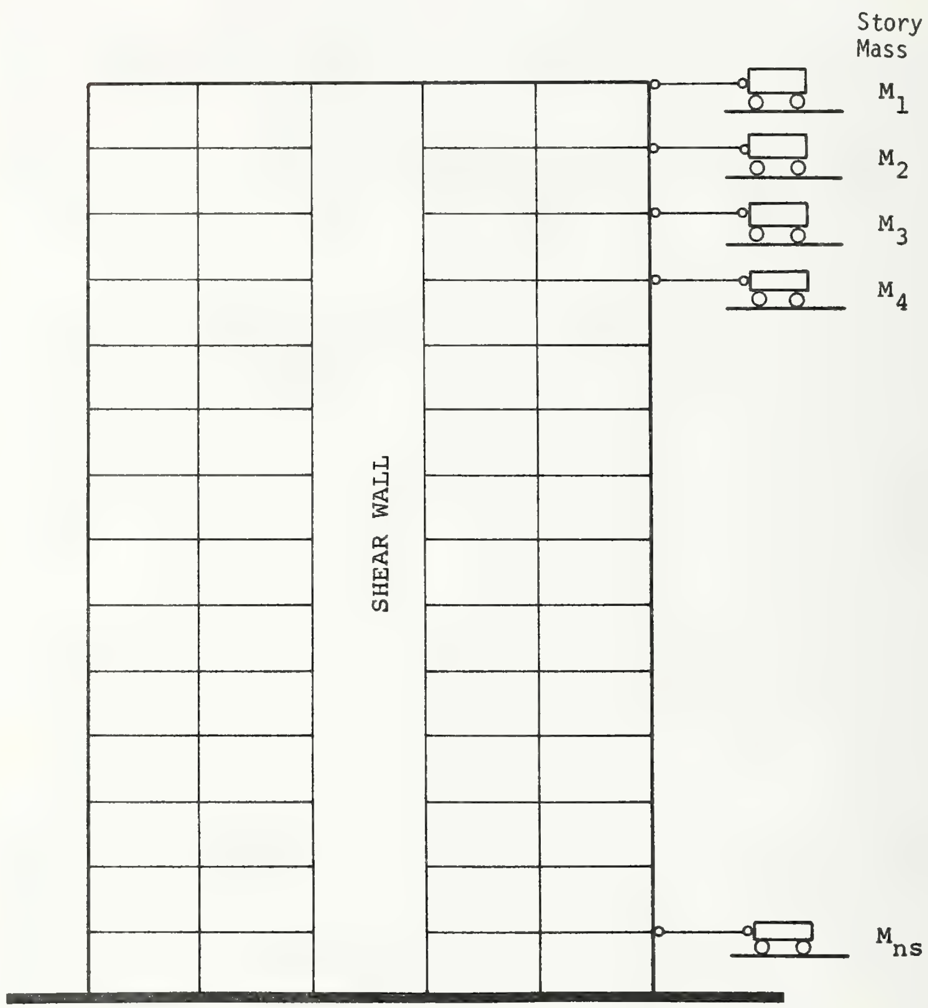


Figure 5. Lumped Mass Model

of μ, and μ is response dependent, an iterative procedure must be used to establish consistent values of damping and response. While this operation seems to be stable and typically converges in a few cycles (three or four), an upper limit (e.g. six) on the number of iterations, ITERMX, is input and used to transfer control out of the iterative loop in case the computations do not converge to within 5%. This may only occur when elasto-plastic response is considered as discussed below.

Two damping options (See Section 3.4 of the main text are available by specifying appropriate values of the variable NDAMP. If NDAMP = 1 the nominal damping curve is used which is applicable to steel frame and reinforced concrete structures. In this case, modal damping ranges from about 2% for $\mu = 0$ up to about 10% for a μ of 3.5. If NDAMP = 2, these values are doubled. NDAMP = 2 is intended to be used for bolted or riveted steel frames, or timber structures.

An effective ductility μ is defined as

$$\mu = \sqrt{E/E_y}$$

where E_y is the maximum energy storage capacity of the structure in the state of uniform incipient yielding, and E is the (hypothetical) strain energy which would be stored if the structure were assumed to remain elastic for the linear response computed. If the computed response is sufficiently large that $\mu > 1$, then by setting LD $\neq 0$, the response of the structure is altered to reflect some of the effects of yielding. These operations are performed by subroutine SPECTR.

Four operations in all are performed in SPECTR:

1) Increase modal period if $\mu > 1$ and LD $\neq$ 0.

2) Interpolate between points defined for the ground site spectrum to compute a spectral velocity, SV.

3) Form an amplification factor $(AF)_\zeta$ to account for structural damping and multiply $(AF)_\zeta \times SV$.

4) Form a second amplification factor $(AF)_\mu$ to account for ductility and multiply $(AF)_\mu \times (AF)_\zeta \times SV$, (LD $\neq$ 0 only). Actually, two different values of $(AF)_\mu$ are computed. One is used to obtain a final spectral velocity SVF for use in computing forces or accelerations and the other is used to obtain a final spectral velocity SVD for computing displacements and velocities.

Thus

$$SVF = (AF)_\mu^F \times (AF)_\zeta \times SV$$

$$SVD = (AF)_\mu^D \times (AF)_\zeta \times SV$$

Referring back to Flow Diagram 5, one may now follow the entire sequence of operations. It is seen that the total response is computed in an iterative manner until the values of μ and ζ converge (or the iteration counter reaches ITERMX).

In computing total response, one of three options is available:

MCØP = 1: First mode response only
MCØP = 2: RSS of first six modes
MCØP = 3: Absolute sum of first six modes.

Interstory drift, pseudo-velocity, and absolute acceleration are computed for each story and passed through the call statements to subroutine DAMAG. In addition, story forces and shears are computed for all three options and are printed for comparative purposes only, unless NØPRT = 1. These latter quantities are not used in damage evaluation.

Structural response to wind (and tornado if ITØR = 1) is evaluated in subroutine STATIC (Flow Diagram 6). The stiffness matrix is first inverted if NMØD $\neq$ 3. Either of subroutines WIND or TRNADØ is then called to compute a distribution of pressure forces for the building. Data input required by WIND is covered in Section 2.3.2. No data are input for TRNADØ. For either NMØD = 1 or 2, the inverted stiffness matrix is used to compute deflection of the building. If NMØD = 3, an alternative method is used as discussed in Section 3.4 of the main text.

Only two simple failure modes are considered for long-span roofs. These are separation due to excessive uplift forces or collapse due to excessive ponding. Response is a binary quantity in either case, fail or no fail, and is determined by whether the respective forces exceed or do not exceed the total vertical support capacity in the upward direction or the capacity of the roof structure in the downward direction. Thus, most of the computation is devoted to determining the forces which are configuration dependent and are included in the response part of the program rather than the loads part. Three alternative methods are provided for computing uplift as indicated in Section 2.3.3. Each of these options is explained in Section 3.4 of the main text.

Potential roof damage to any building may be evaluated for the two modes of failure mentioned above. The intent, however, is

that long-span roofs will be of main concern since larger uplift forces are developed for longer spans and adequate support is more difficult to achieve. Ponding is not likely to create excessive loading for short-span roofs and, of course, will not occur with proper drainage.

1.4 Damage

Potential damage to a building which may result from exposure to the environmental loads computed for the building site, is evaluated in Subroutine DAMAG (Flow Diagram 8). Damage is expressed in percent of total damage on a story by story basis. Damage is computed independently for earthquake, wind and tornado. It is segregated into three categories: structural, nonstructural and glass. In the case of structural damage, the damage is further subdivided into damage to frame, walls, and diaphragms.

The key response parameters used to predict damage in each case are outlined below.

1. <u>Earthquake</u>
   a. Structural: interstory drift
   b. Nonstructural: floor velocity or acceleration
   c. Glass: interstory drift
2. <u>Wind or Tornado</u>
   a. Structural: interstory drift
   b. Partitions: interstory drift
   c. Glass: direct pressure

For earthquake, nonstructural damage includes partitions as well as other types of nonstructural damage. With the exception of nonstructural damage due to earthquake, damage is computed by comparing the key response parameter to a strength capacity

characterized by a nominal value and a dispersion parameter (coefficient of variation) which are specified by the user (See Section 3.4 of the main text of this report.) Thus damage is considered to vary in a continuous manner with response level. Although a probabilistic interpretation of the distribution functions is plausible and has some appeal, it is not essential. Thus, some of the conceptual obstacles which arise in trying to justify a particular function, which happens to follow from certain well-defined statistical phenomena, may be avoided. The salient feature of the damageability curves used in this program is their ability to represent the tendency for percent damage to increase monotonically (i.e. in a non-decreasing manner) with response level. As stated at the outset, it is deemed to be the user's responsibility to select capacity distribution parameters to fit a particular situation.

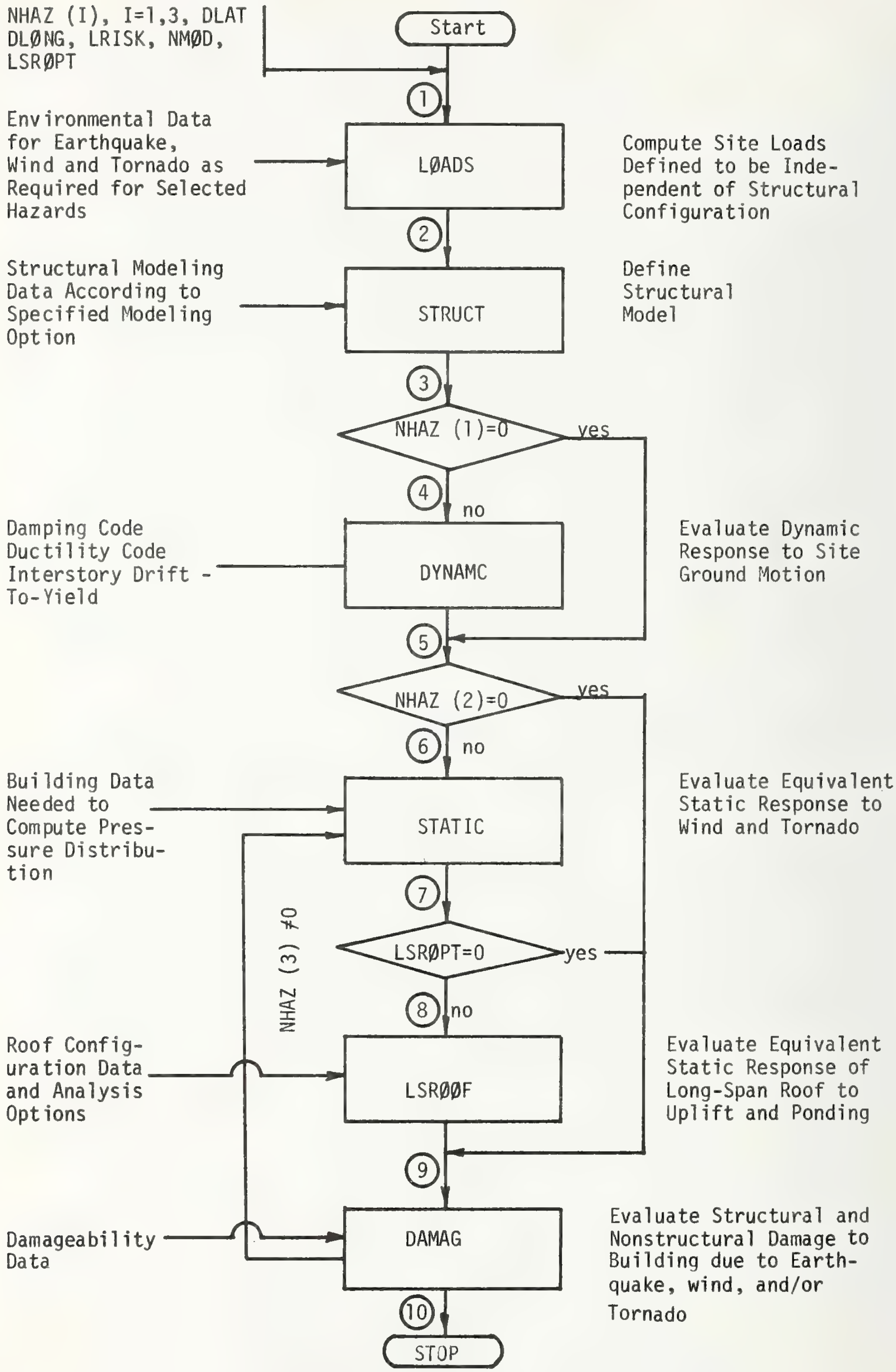
In computing nonstructural damage due to earthquake, percent of component damage is computed on the basis of a Modified Mercalli Intensity (MMI) as discussed Section 3.4 of the main text. Values for MMI at each story are computed form both floor acceleration and velocity and the largest of these is used to compare percent damage.

Damage to long-span roof is considered to be either zero or 100%, corresponding to the fail/no-fail response parameters. Appropriate statements are printed out by DAMAG.

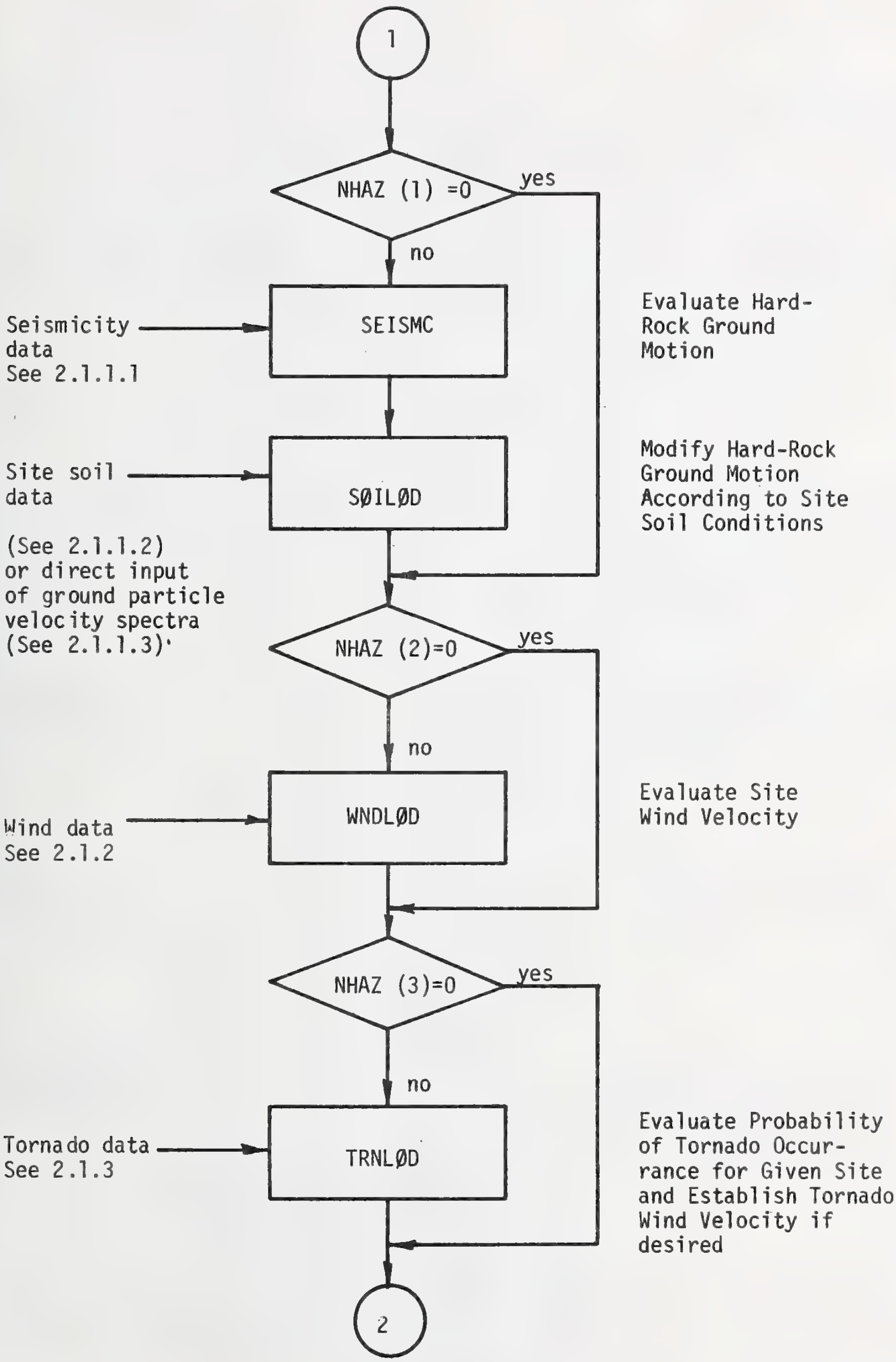
In computing tornado damage, the program cycles through DAMAG once, and then goes back to STATIC, computes pressure forces and drift for tornado and then calls DAMAG a second time. Thus, while the pressure forces and drift are different for tornado than they are for wind, the same damage algorithms and damageability data are used.

1.5 Flow Diagrams

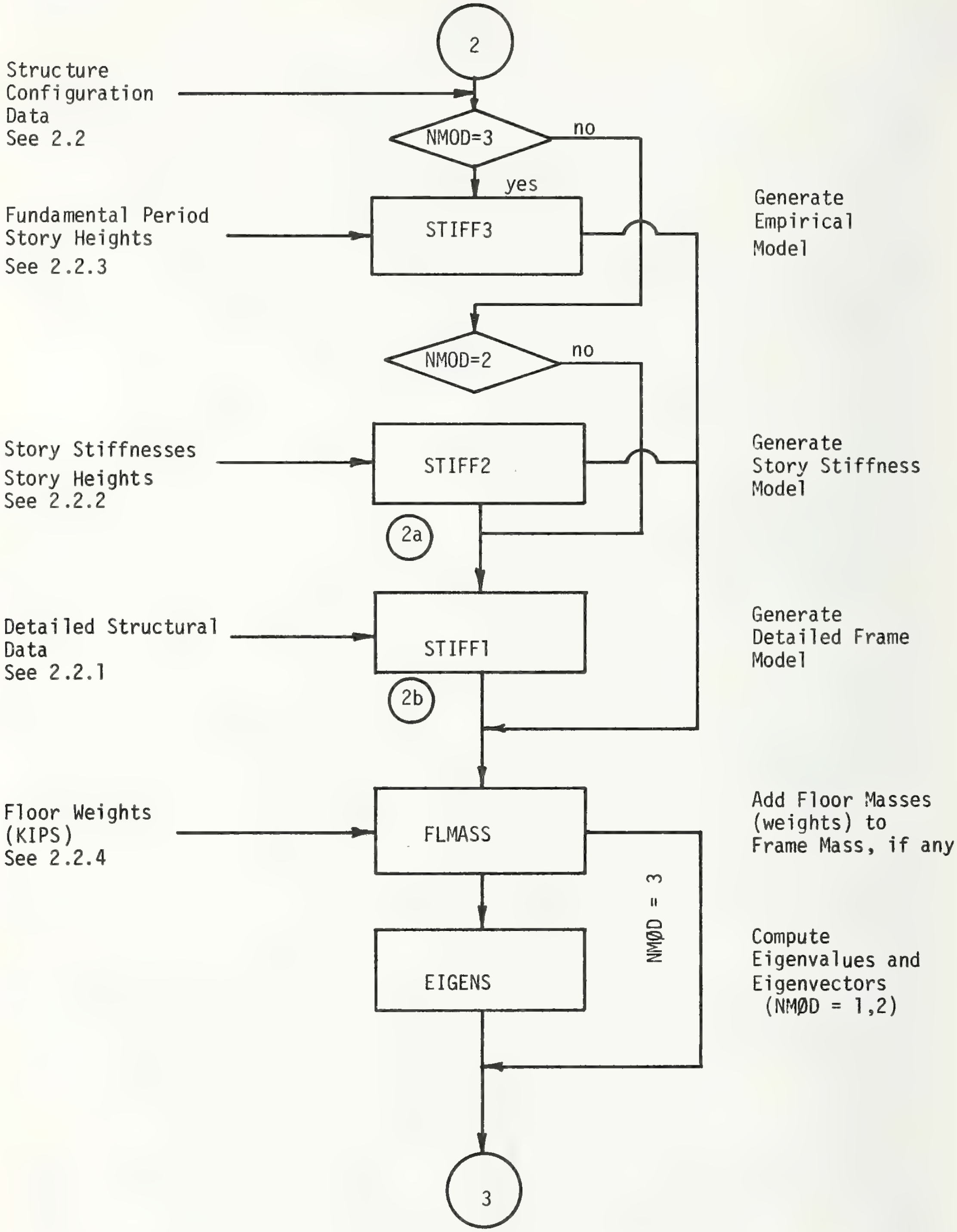
Flow Diagram 1. MAIN Program



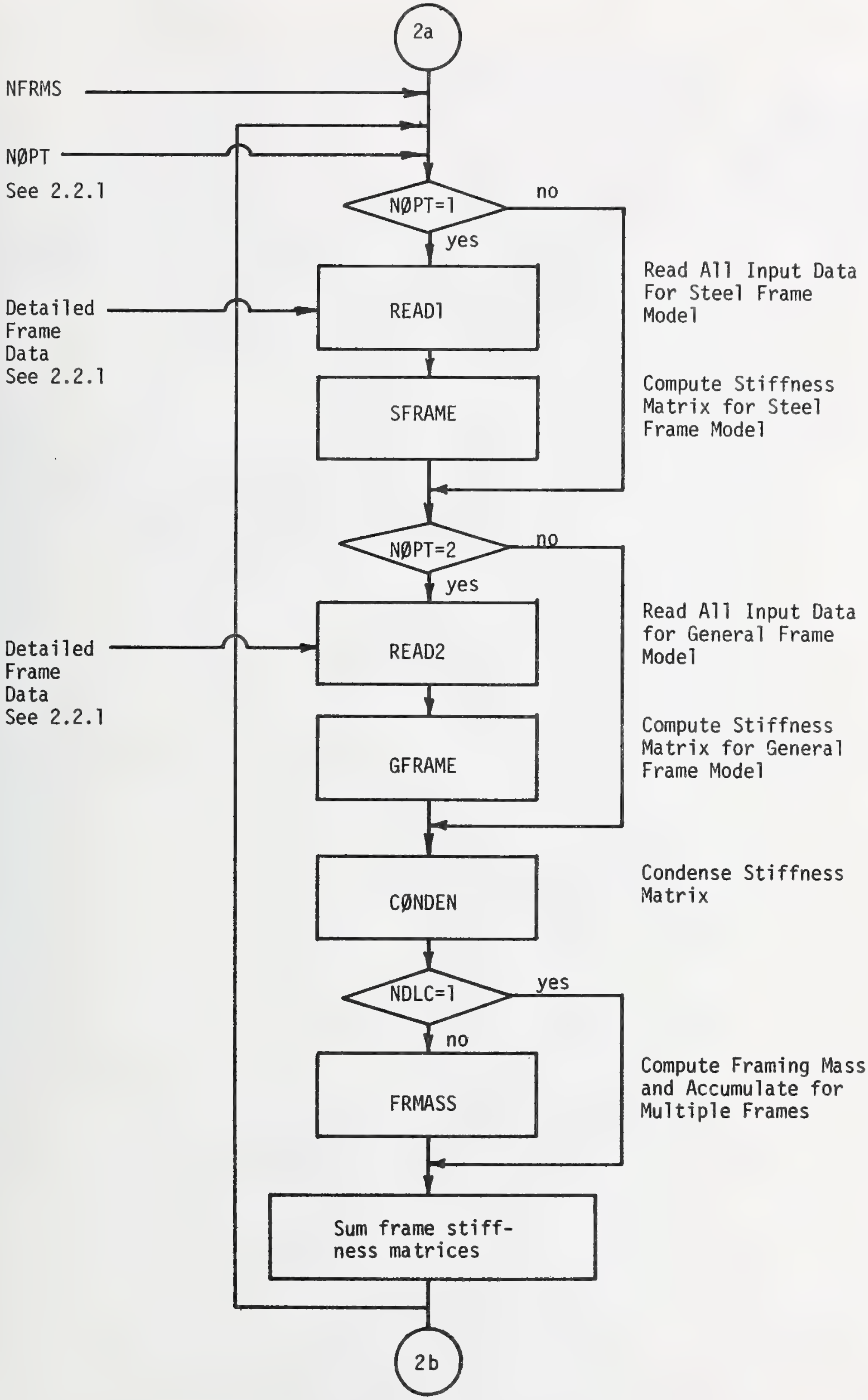
Flow Diagram 2. Subroutine LØADS



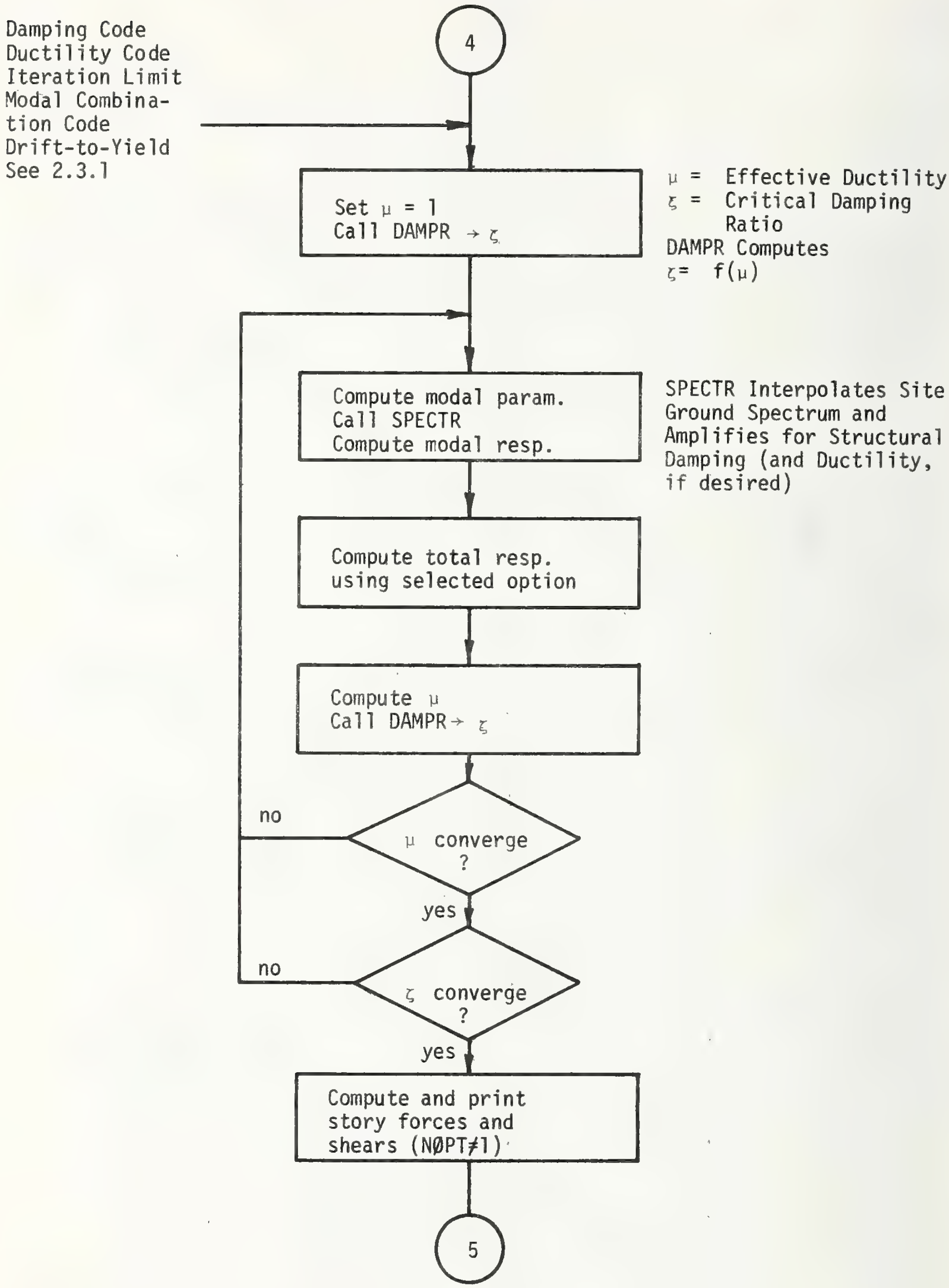
Flow Diagram 3. Subroutine STRUCT



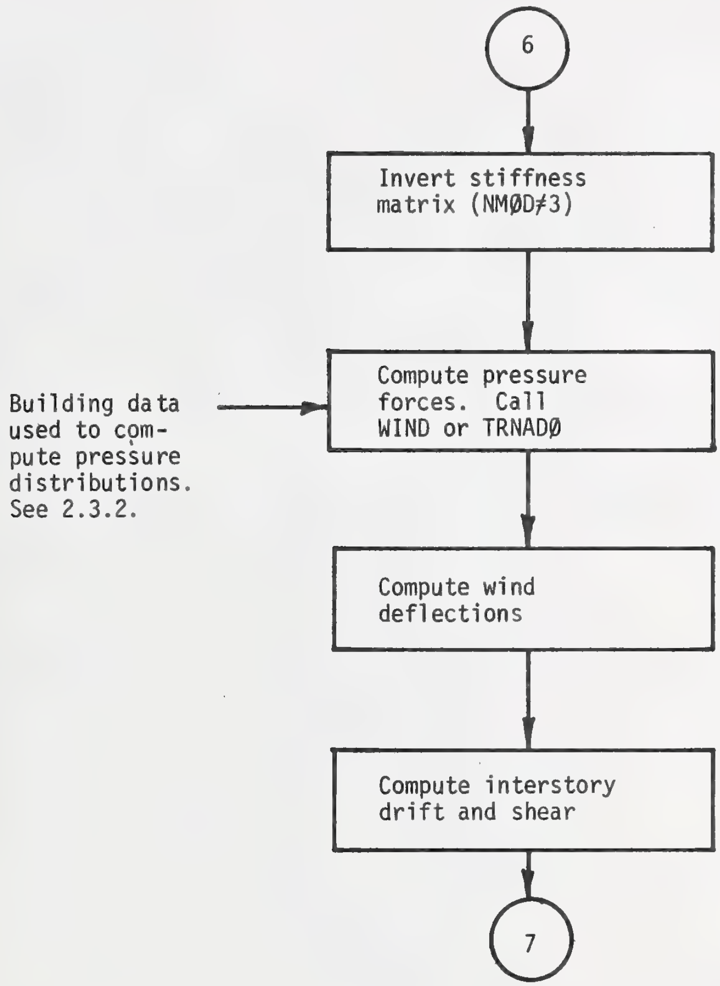
Flow Diagram 4. Subroutine STIFF1



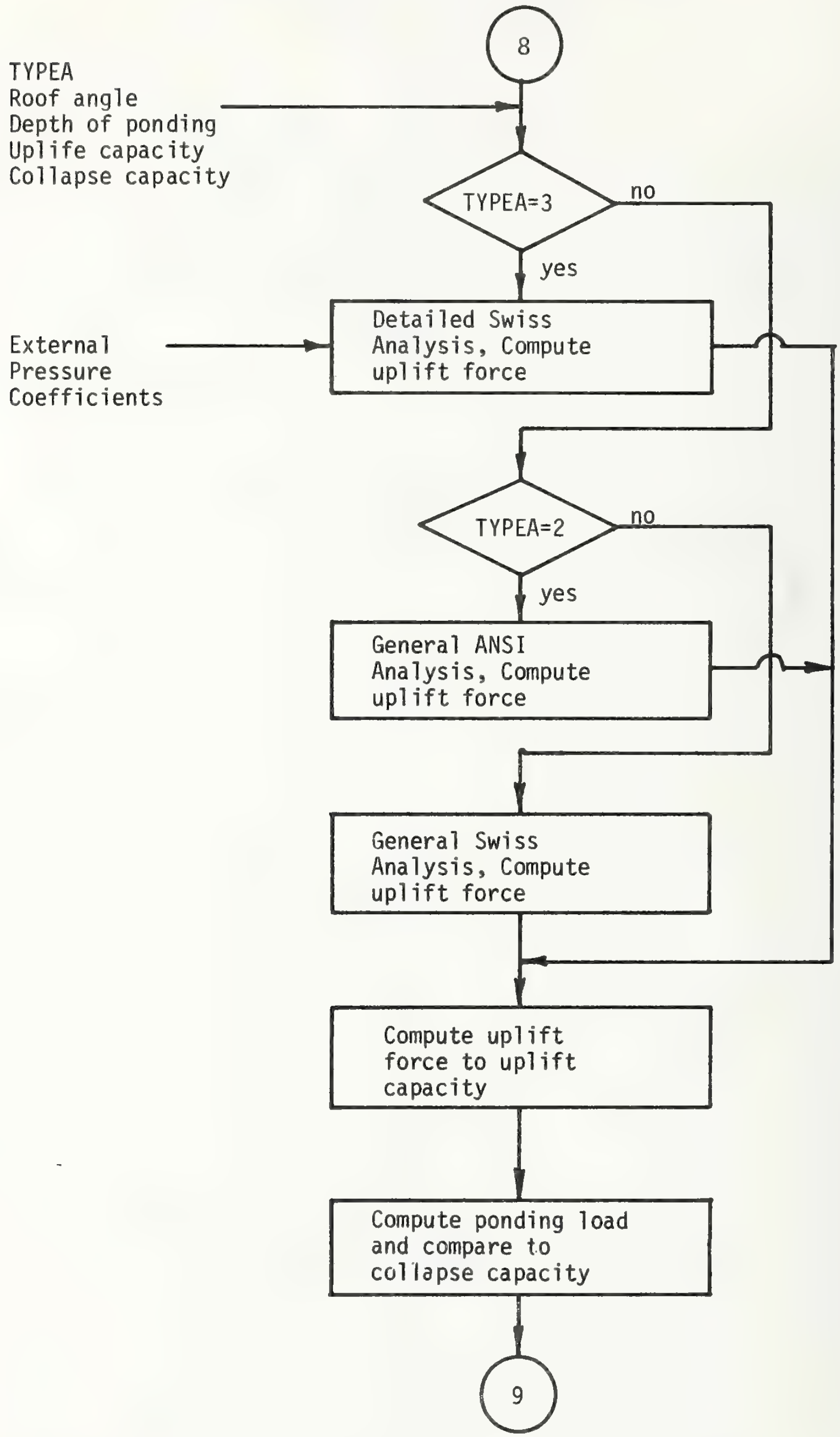
Flow Diagram 5. Subroutine DYNAMC



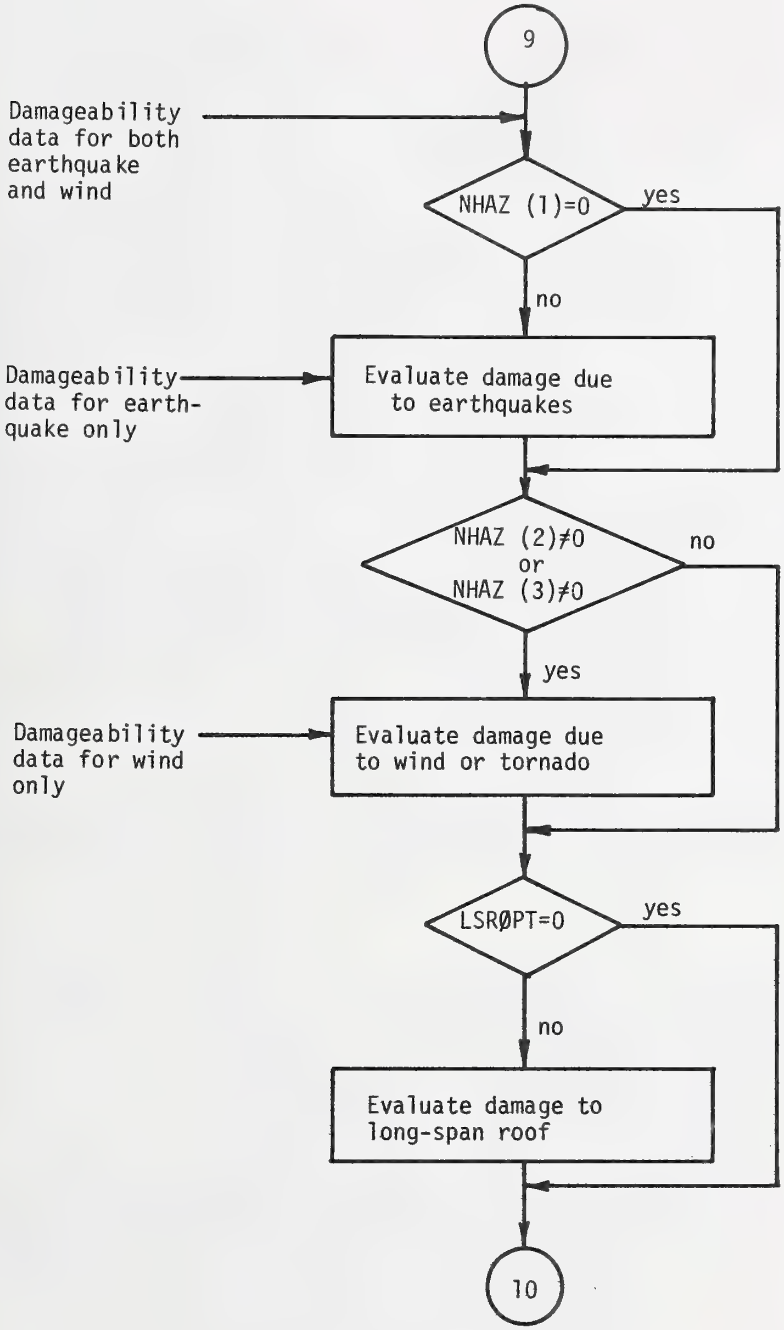
Flow Diagram 6. Subroutine STATIC



Flow Diagram 7. Subroutine LSRØØF



Flow Diagram 8. Subroutine DAMAG



1.6 Capacity

The following restrictions apply to each two-dimensional frame generated; none of the restrictions may be exceeded:

Number of stories	30
Number of bays	9
Beam section types	99
Column section types	99
Total number of beams	200
Total number of columns	200

There is no limit to the number of frames which may be generated.

Stiffness matrices of framed structures are usually well conditioned and round-off error is rarely a problem. The program basically works in single precision arithmetic; therefore, care should be taken when members with very large relative stiffnesses are used. A good rule of thumb is to avoid the use of relative stiffness ratios greater than 10^4. Numerical problems can occur in both matrix equation solving subroutines and the eigenproblem subroutine if an ill-conditioned problem is formulated.

2.0 INPUT PREPARATION

Input is free form;* that is, each card is identified by its logical sequence in the input stream (no card identification code is included), and each field within a card is delimited by commas and identified by its sequence within the card. Any omitted fields are identified by two adjacent commas, i.e. n adjacent commas signify n-1 adjacent fields which are omitted. Data entered in vector form, e.g. VEL(I), I=1, NPTS as shown in Section 2.1.2, are entered in consecutive fields on one card or more as required. Numerical values must be input in either integer or floating point format as indicated by I or F. All units are in KIPS, INCHES and SECONDS except as noted.

The data for a computer run must be organized in the sequence described in the following paragraphs.

Input to Program MAIN

Card	No. of Cards	Input Variables
A	1	TITLE
B	1	NHAZ (I), I = 1,3
C	1	DLAT, DLØNG
D	1	LRISK, NMØD, LSRØPT

A: Title Card - Up to 72 characters beginning in Column 1.

B: Hazards Option Card

Field No.	Symbolic Code	Description of Contents
1 I	NHAZ(1)	≠ 0 Consider earthquake
2 I	NHAZ(2)	≠ 0 Consider wind
3 I	NHAZ(3)	≠ 0 Consider tornado

*Free form input may not be used on the CDC-3600 computer. A special version of the program is available for this machine. See Appendix.

C: Site Location

Site location is specified by reading in latitude and longitude relative to standard global coordinates.

Field No.	Symbolic Code	Description of Contents
1 F	DLAT	North Latitude
2 F	DLONG	West Longitude

D: Program Control Options

Field No.	Symbolic Code	Description of Contents
1 I	LRISK	≠ 0 Exercise risk option for earthquake
2 I	NMØD	Structural Modeling Option = 1 Detailed Frame = 2 Story Stiffness = 3 Empirical
3 I	LSRØPT	≠ 0 Evaluate damage to long-span roof

2.1 Loads

2.1.1 Earthquake (See Section 3.4 of the main text.)

2.1.1.1 Input to Subroutine SEISMC

Card	No. of Cards	Input Variables	
A	1	EM, RBAR	(LRISK = 0)
B	1	LP	(LRISK ≠ 0)
C	1	RNI	(LP = 0)
D	1	BLIFE, PNØC	(LP ≠ 0)
E	1	A, ASIG, RBAR	
F	1	ENSIG, EMMAX	
G	1	LCØP	
H	1	C1, C2, C3	(LCOP ≠ 0)
I	1	CA1, CA2	
J	1	CD1, CD2	

A: Deterministic Earthquake (LRISK = 0)

Field No.	Symbolic Code	Description of Contents
1 F	EM	Richter Magnitude for deterministic earthquake
2 F	RBAR	Hypocentral distance from building site to earthquake source (miles)

B: Life and Probability Option (LRISK ≠ 0)

Field No.	Symbolic Code	Description of Contents
1 I	LP	= 0 : User input return period ≠ 0 : User input life and probability of non-occurrence

C: Return Period (LRISK ≠ 0, LP = 0)

Field No.	Symbolic Code	Description of Contents
1 F	RNI	Return period in years

D: Life and Probability (LRISK ≠ 0, LP ≠ 0)

Field No.	Symbolic Code	Description of Contents
1 F	BLIFE	Life expectancy of building in years
2 F	PNØC	Desired probability that an earthquake of computed magnitude or greater will not occur during a period of BLIFE.

E: Seismicity Data (LRISK ≠ 0)

Field No.	Symbolic Code	Description of Contents
1 F	A	Seismicity obtained from map for specified Location
2 F	ASIG	Standard deviation of A also from map
3 F	RBAR	Effective hypocentral distance of risk earthquake (miles)

F: Parameters for Specifying Risk Earthquake (See Section 3.4 of the main text.) of Magnitude EM

$$EM = \begin{cases} M = 1/.9 \left[(A + ENSIG*ASIG) - \log_{10} N \right] & :M < EMMAX \\ EMMAX & :M \geq EMMAX \end{cases}$$

where

$$N = \begin{cases} 1/RNI & :LP = 0 \\ -\ln(PN\emptyset C)/BLIFE & :LP \neq 0 \end{cases}$$

Field No.	Symbolic Code	Description of Contents
1 F	ENSIG	Number of standard deviations above mean seismicity used to determine Engineering Seismicity
2 F	EMMAX	User imposed upper limit on magnitude of Risk Earthquake

G: Input Option

Field No.	Symbolic Code	Description of Contents
1 I	LCØP	= 0 Use internal constants for computing hard rock ground motion from EM and RBAR ≠ 0 User supply constants if available from independent source

H: Velocity Constants (LCØP ≠ 0)

If LCØP = 0, the user must input constants to be used in computing hard-rock ground velocity from the formula

$$V_r = C1 \times 10^{C2(EM)} \times RBAR^{-(C3)}$$

These may be computed independently by the user based on regression analysis if data are available (See Section 3.4 of the main text), or determined by an other means available to him, e.g. recommendations by another source.

Field No.	Symbolic Code	Description of Contents
1 F	C1	See above formula
2 F	C2	See above formula
3 F	C3	See above formula

I: <u>Acceleration Constants (LCØP ≠ 0)</u>

If LCØP ≠ 0, the user must input constants (Refer to card H above) to be used in computing hard-rock ground acceleration from the formula

$$\log A_r = CA1 + CA2 \times \log V_r$$

Field No.	Symbolic Code	Description of Contents
1 F	CA1	See above formula
2 F	CA2	See above formula

J: <u>Displacement Constants (LCØP ≠ 0)</u>

If LCØP ≠ 0, the user must input constants (Refer to card H above) for computing hard-rock ground displacement from the formula

$$\log D_r = CD1 + CD2 \times \log V_r$$

Field No.	Symbolic Code	Description of Contents
1 F	CD1	See above formula
2 F	CD2	See above formula

2.1.1.2 Input to Subroutine SØILØD (See Section 3.4 of the main text.)

Card No.	No. of Cards	Input Variables
A	1	IPRØC, SIG

A: <u>Soil Model Option and Standard Deviation Specification</u>

Field No.	Symbolic Code	Description of Contents
1 I	IPRØC	A code for which soil model is to be specified.*
2 F	SIG	The number of standard deviations to be applied to the calculated amplification spectrum. SIG=0.0 is for mean analysis; SIG=1.0 is for 1 Sigma analysis, etc.

* IPRØC = 1 → Complex Model
= 2 → Semi-Complex Model
= 3 → Simple Method (a, b or c)
= 4 → Simple Method (d)
= 5 → Ground Particle Velocity Spectra Input directly

2.1.1.2.1 Complex Model: IPRØC = 1

Card	No. of Cards	Input Variables
A	1	ITYPE, N
B	N	THICK(I), DENSI(I), VELØC(I), PHI(I)

A: <u>Option Card</u>

Field No.	Symbolic Code	Description of Contents
1 I	ITYPE	= 1 Complex Model ≠ 1 Semi-Complex Model
2 I	N	Number of soil layers

B: Complex Model Data

Read data in ascending order , i.e. from base-rock up.

Field No.	Symbolic Code	Description of Contents
1 F	THICK(I)	Layer Thickness (ft)
2 F	DENSI(I)	Layer Wet Density (pcf)
3 F	VELØC(I)	Layer SH-Wave Velocity (ft/sec)
4 F	PHI(I)	Layer damping (fraction of critical)

2.1.1.2.2 Semi-Complex Model : IPRØC=2

Card	No. of Cards	Input Variables
A	1	ITYPE, N
B	1	DAMP
C	N	T(I), DE(I), W(I)

A: Option Card

Field No.	Symbolic Code	Description of Contents
1 I	ITYPE	= 1 Complex Model ≠ 1 Semi-Complex Model
2 I	N	Number of Soil Layers

B: Top Layer Damping Card

Field No.	Symbolic Code	Description of Contents
1 F	DAMP	Damping of Top Layer (fraction of critical)

C: Semi-Complex Model Data

Field No.	Symbolic Code	Description of Contents
1 F	T(I)	Layer Thickness (ft)
2 F	DE(I)	Layer Wet Density (pcf)
3 F	W(I)	Layer Moisture Content (% of Dry Weight)

2.1.1.2.3 Simple Method (a,b,c) IPRØC=3

Card	No. of Cards	Input Variables	
A	1	IAPRØ, N	
B	N	T(I),DE(I),W(I)	(IAPRØ=1)
C	1	ISØIL,H2Ø	(IAPRØ=2)
D	N	V(I), DE(I)	(IAPRØ=3)

A: Simple Method Option Card

Field No.	Symbolic Code	Description of Contents
1 I	IAPRØ	= 1 Simple Method (a) = 2 Simple Method (c) = 3 Simple Method (b)
2 I	N	Number of Layers if IAPRØ=1, 3. N=0 if IAPRØ=2. Zero must appear on the Data Card.

B: Simple Method (a) Data Card (See 2.1.1.2.2 C, above)

C: Simple Method (c) Data Card

Field No.	Symbolic Code	Description of Contents
1 I	ISØIL	Soil Code for DAF calculation. See Table 1.
2 F	H2Ø	Depth to Water Table in Feet.

Table 1. Soil Codes for Simple Method (c)

ISØIL	Material
1	Fill or Soft Soil
2	Sandy and Clayey Ground
3	Rock Debris
4	Gypsum and Marl
5	Limestone and Sandstone
6	Granite

D: Simple Method (b) Data Card

Field No.	Symbolic Code	Description of Contents
1 F	V(I)	Layer Velocity (ft) See sample equations - Ref. 3.20
2 F	DE(I)	Layer Wet Density (pcf)

2.1.1.2.4 Simple Method (d) : IPRØC=4 (Section 3.4 of main text)

Card	No. of Cards	Input Variables
A	1	ICØDE, ISAT
B	1	H,DEN

A: Simple Method (d) Data Card

Field No.	Symbolic Code	Description of Contents
1 I	ICØDE	Geologic Period Code See Table 2.
2 I	ISAT	Saturation Code = 1 Soil is Saturated ≠ 1 Soil is Unsaturated

Table 2. Geologic Codes for Simple Method (d)

ICODE	Period	Era	Age (x 10^6 years)
1	Holocene	Cenozoic	.011
2	Quaternary		2.5 *
3	Pleistocene		1
4	Pliocene		16
5	Miocene		26
6	Oligocene		35
7	Eocene		43
8	Cretaceous	Mesozoic	93
9	Juraissic		152
10	Triassic		175
11	Permian	Paleozoic	192
12	Pennsylvanian		220
13	Mississippian		245
14	Devonian		284
15	Silurian		355
16	Ordovician		390
17	Canadian		415
18	Ozarkian		440
19	Upper-Middle Cambrian		490
20	Lower Cambrian		515

*Note: In establishing the ICODE shown, the chronological sequence was not followed for these two periods.

B: Simple Method (d) Data Card

Field No.	Symbolic Code	Description of Contents
1 F	H	Depth of Soil Model,usually a minimum of 1/2 maximum plan dimension (ft)
2 F	DEN	Soil Wet Density (pcf)

If user desires, he may use the internally set value of DEN = 135 pcf by setting DEN$\leq$0.0.

2.1.1.3 User Input of Specified Site Particle Velocity Spectrum

If the user desires, he may input his own site particle velocity spectrum. This option is invoked by specifying IPRØC = 5 (See Section 2.1.1.2). Following Card A of input to subroutine SØILØD, three additional cards are required. On the first, the number of data points, NDATA, to be input is specified. On the second, values of the input period, TIN (I) are specified. On the third, corresponding values of input velocity, YIN(I), are specified. No other input data are required.

Any number of data points may be input. Subrountine SØILØD uses linear interpolation to compute the vectors T(I) and Y(I) corresponding to period increments of 0.1 sec. ranging from 0.1 sec. to 10 sec. One word of caution: although the user may specify as few as two input spectrum data points, the program will compute 100 spectrum points by linear not logarithmic interpolation. Thus if the user has picked points off a log-log plot, intermediate points may deviate significantly from straight lines on the log-log plot. To adequately define the entire spectrum from 0.1 sec. to 10 sec. periods, at least 8 to 10 points should be input.

2.1.2 Wind: Input to Subroutine WNDLØD

Card	No. of Cards	Input Variables
A	1	ISITE, ITEST, ITY, ISHAPE
B	1	SIG (ITEST = 1)
C	1	NPTS (ITEST = 1)
D	1	VEL(I), I = 1, NPTS (ITEST = 1)
E	1	RETRN(I), I = 1, NPTS (ITEST = 1)
F	1	PERIOD (ITY = 1, ITEST = 1)
G	1	BLIFE, PROB (ITY = 2, ITEST = 1)
H	1	VF (ITEST = 2)

A: Wind Load Control Card

Field No.	Symbolic Code	Description of Contents
1 I	ISITE	Code that describes terrain surrounding the structure-Table 3
2 I	ITEST	= 1 Statistical Analysis = 2 Deterministic Analysis
3 I	ITY	ITY specifies statistical approach to be used. = 1 Return Period Analysis = 2 Life and Probability of non-occurrence analysis = 0 Deterministic Analysis
4 I	ISHAPE	= 1 External Pressure Coefficients stored in program will be used = 2 User will specify external pressure coefficients

B: Specification of Standard Deviation

Field No.	Symbolic Code	Description of Contents
1 F	SIG	Number of standard deviations for specification of wind velocities SIG = 0.0 is for mean analysis

Table 3. Power Law Exponents for Various Terrains and Input Codes

ISITE	Description of the Terrain	Power Law Exponent ($1/\alpha$)
1	For centers of large cities	1/3
2	For wooden countryside, parkland, towns, outskirts of large cities, rough coastal belts	1/4.5
3	For open country, flat coastal belts, small islands situated in large bodies of water, prairie grassland, tundra, etc.	1/7

C: Statistical Analysis Card

Field No.	Symbolic Code	Description of Contents
1 I	NPTS	Number of velocities and return periods from Thom's maps (Fig. 6 to 10 and Table 4. for use in regression analysis.

D: Wind Velocities for Statistical Analysis

Field No.	Symbolic Code	Description of Contents
1 F	VEL(I), I=1, NPTS	Velocities (fastest-mile, mph) from Thom's maps for regression analysis

E: Wind Velocity Return Periods for Statistical Analysis
(for use if ITEST = 1

Field No.	Symbolic Code	Description of Contents
1 F	RETRN(I), I=1, NPTS	Return periods in years corresponding to velocities in D above

F: Return Period

Field No.	Symbolic Code	Description of Contents
1 F	PERIOD	Return period in years to find design velocity use the results of regression analysis from C, D, E above

G: Life Probability of Non-occurrence Analysis

Field No.	Symbolic Code	Description of Contents
1 F	BLIFE	Life of the structure in years.
2 F	PROB	Probability that the calculated wind velocity from regression analysis will not be exceeded during BLIFE.

H: Deterministic Wind Velocity

Field No.	Symbolic Code	Description of Contents
1 F	VF	User value of wind velocity - fastest mile data in mph.

Figure 6. Mean Return Wind Velocity in Miles Per Hour - 2 Year Return Period

Figure 7. Mean Return Wind Velocity in Miles Per Hour - 10 Year Period

Figure 8. Mean Return Wind Velocity in Miles Per Hour - 25 Year Return Period

Figure 9. Mean Return Wind Velocity in Miles Per Hour - 50 Year Return Period

Figure 10. Mean Return Wind Velocity in Miles Per Hour - 100 Year Return Period

Table 4. Hawaii Fastest Mile Data (mph) at Sea Level*

Exposure	Return Period in Years 2	10	25	50	100
Leeward (Westerly)	38	51	60	67	75
Windward (Easterly)	42	59	70	80	91

* The following footnote applies only to Hawaii.

Since the data of Table 4 is taken at sea level stations, it must be converted to an equivalent fastest mile wind velocity at 30 feet above the ground for a site at an elevation Z feet above sea level. The user must do the following conversion before entering the data into the wind program:

$$V_{Z30} = V_{30} \left(\frac{Z + 30}{30}\right)^{1/7}$$

where

V_{30} = a velocity from Table 4.

Z = elevation of site above sea level in feet.

V_{Z30} = new fastest mile wind velocity at 30 feet above ground for the site.

2.1.3 Tornado: Input to Subroutine TRNLØD (See Section 3.4 of the main text.)

Card	No. of Cards	Input Variables
A	1	BL, F1, ITØR
B	1	VT (ITØR ≠ 0)

A: Site Card

Field No.	Symbolic Code	Description of Contents
1 F	BL	Building Life
2 F	F1	Number of tornados per year from Figure 11.
3 I	ITØR	= 0 Omit Wind Loads ≠ 0 Compute static response and damage due to pressure loads

B: Velocity Card

Field No.	Symbolic Code	Description of Contents
1 F	VT	Tornado Wind Velocity

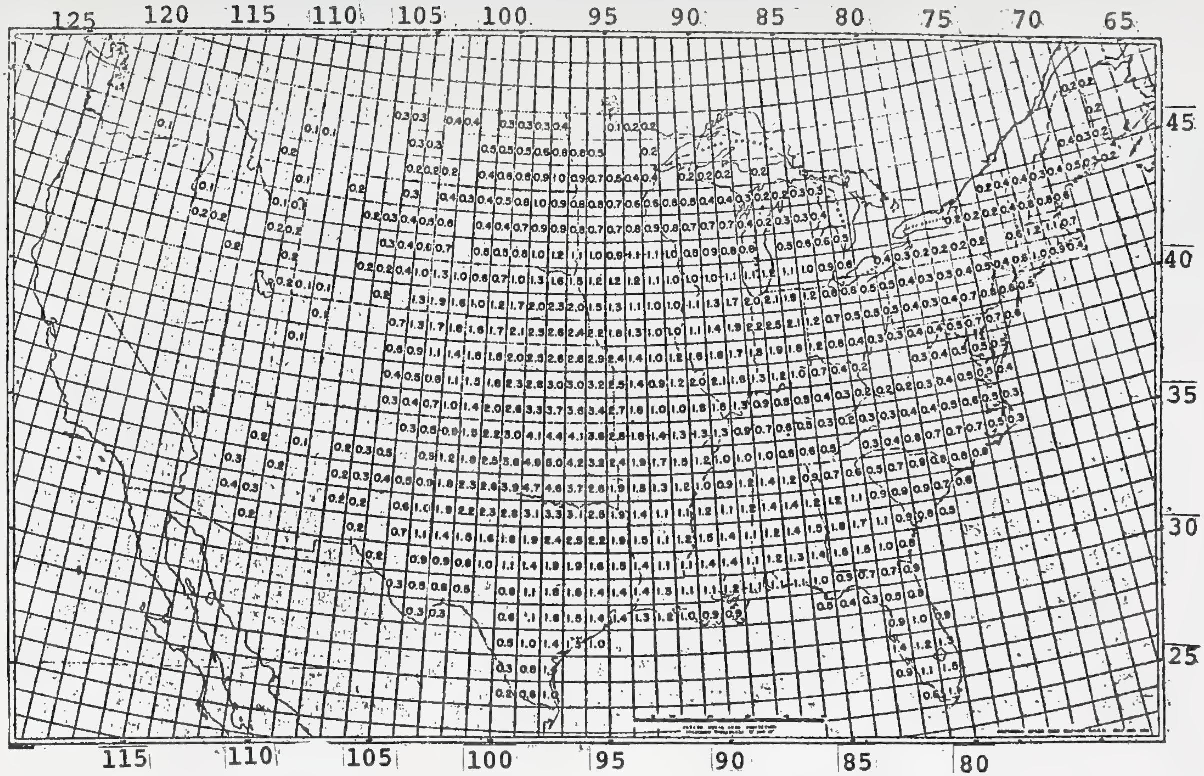


Figure 11. Mean Annual Frequency of Tornados
1953-1962, Parameter F1.

2.2 Structural Model: Input to Subroutine STRUCT

See Section 3.4 of the main text.

Card	No. of Cards	Input Variables
A	1	NS, TWB, TLB, PHR, NØPRT

A: Structure Configuration Card

Field No.	Symbolic Code	Description of Contents
1 I	NS	Number of stories
2 F	TWB	Total width of building
3 F	TLB	Total length of building
4 F	PHR	Parapet height
5 I	NØPRT	= 1 Suppress portions of printed output

2.2.1 Level 1 - Detailed Frame Model: Input to Subroutine STIFF1

<table>
<tr><th>Card</th><th colspan="2">No. of Cards</th><th>Input Variables</th></tr>
<tr><td>A</td><td colspan="2">1</td><td>NFRMS</td></tr>
<tr><td rowspan="2">B</td><td rowspan="2">NFRMS</td><td>1</td><td>NØPT</td></tr>
<tr><td></td><td>See Sub-Chart for each NØPT</td></tr>
</table>

A: Number of Frames

Any number frames may be used to model a building. Since the model is two-dimensional, stiffness matrices for the various frames are superposed (summed). Each frame is assumed to lie in a vertical plane parallel to the direction of motion. Thus, for example, if the outside frames contain concrete shearwalls while the inner frames are constructed primarily of steel beams and columns, each may be modeled separately and their contributions to the overall stiffness of the structure will be additive, analogous to springs acting in parallel.

The framing options presented herein offer the user considerable latitude in types of building framing options. However, it should be noted that the user may, by placing "near zero" virtual members (properties down to 10^{-4} magnitude levels may be used without numerical ill-conditioning) extend the range of framing types. K bracing and other bracing systems may be handled in this manner. Once experience is gained in this area the program usage is greatly inhanced.

Field No.	Symbolic Code	Description of Contents
1 I	NFRMS	Number of frames to be used in detailed model

B: Frame Option Card

Individual frames for a particular building may be modeled using either NØPT = 1 or 2 in any combination. The only restriction is that story heights for all frames be the same.

Field No.	Symbolic Code	Description of Contents
1 I	NØPT	= 1 Steel frame (may have non-rigid joints) = 2 General frame (used for concrete structures)

Sub-Chart for NØPT = 1: Steel Frame Model

Card	No. of Cards		Input Variables
C	1		E, NB, NBT, NCT, NBB, NBRT, NRFJ, NDLC
D	NBT		J, AB(J), IB(J), WB(J)
E	NCT		J, AC(J), IC(J), WC(J)
F	NBRT		J, ABR(J) ABR = Area of brace
G	NB*		NUM, BW
H	NS*		NUM, SH
I	NS	NB*	NUM, BT, (IFR,A,B,SCJ,SCK)[+]
J		NC*	NUM, CT, (IFR,A,B,SCJ,SCK)[+]
K		NBB	BN, BT1, BT2

\+ Omit if NRFJ=1

* May be less (refer to detailed explanation)

Sub-Chart for NØPT = 2: General Frame Model

Card	No. of Cards		Input Variables
C	1		NB, NBT, NCT, E, G, EB, GB, WTB, WTC, NDLC
D	NBT		J, B1, D1, ISECT/T1, T2
E	NCT		J, B1, D1, ISECT/T1, T2
G	NB*		NUM, BW, BL1, AL1
H	NS*		NUM, SH
I	NS	NB*	NUM, BT
J		NC*	NUM, CT

* May be less (refer to detailed explanation)

C: Frame Description Card

Only one Frame Description card is used per frame. If NØPT = 1, the card contains:

Field No.	Symbolic Code	Description of Contents
1 F	E	Young's modulus
2 I	NB	Number of bays
3 I	NBT	Number of beam sections
4 I	NCT	Number of column sections
5 I	NBB	Number of braced bays
6 I	NBRT	Number of bracing types
7 I	NRFJ	If NRFJ=1, frame joints are non-rigid.
8 I	NDLC	If NDLC=1, the dead load of the framing is not included in the building mass.

If NØPT = 2, the card contains:

Field No.	Symbolic Code	Description of Contents
1 I	NB	Number of bays
2 I	NBT	Number of beam sections
3 I	NCT	Number of column sections
4 F	E	Young's modulus for columns
5 F	G	Shear modulus for columns
6 F	EB	Young's modulus for beams
7 F	GB	Shear modulus for beams
8 F	WTB	Weight of beam (lbs/cu. ft.)
9 F	WTC	Weight of column (lbs/cu. ft.)
10 I	NDLC	If NDLC=1, the dead load of the framing is not included in the building mass.

D. <u>Beam Properties Card</u>

The Beam Properties card is used to override beam properties already included in the data base or to add additional beam properties for use in this particular run (refer to Table 5). The total number of cards must equal the number entered for NBT in the Frame Description card. If NØPT=1, the card contains:

Field No.	Symbolic Code	Description of Contents
1 I	J	Beam number; if it is between 1 and 81, it overrides corresponding properties in the data base; if it is between 82 and 99, it adds additional properties to the data base.
2 F	AB	Area ($in.^2$)
3 F	IB	Moment of inertia ($in.^4$)
4 F	WB	Weight (lb/ft)

If NØPT = 2, the card contains:

Field No.	Symbolic Code	Description of Contents
1 I	J	Beam number
2 F	B1	Beam dimension, see Fig. 12
3 F	D1*	Beam dimension, see Fig. 12
4 I	ISECT	Beam section code, see Figure 12
1 F	T1	Beam dimension } enter values on next card if ISECT >2
2 F	T2	Beam dimension } enter values on next card if ISECT >2

*If ISECT = 2, D1 is not used in computation. However, the beam properties card must still contain 4 fields. Either two adjacent commas or a dummy value must be specified.

Table 5. Beam Sections Included in Stored Data Base

Beam No.	Section	Beam No.	Section
1	W16X 26	42	94
2	31	43	100
3	36	44	110
4	40	45	120
5	45	46	130
6	50	47	145
7	58	48	160
8	64	49	W27X 84
9	71	50	94
10	78	51	102
11	88	52	114
12	96	53	145
13	W18X 35	54	160
14	40	55	177
15	45	56	W30X 99
16	50	57	108
17	55	58	116
18	60	59	124
19	64	60	132
20	70	61	172
21	77	62	190
22	85	63	210
23	96	64	W33X 118
24	105	65	130
25	114	66	141
26	W21X 44	67	152
27	49	68	200
28	55	69	220
29	62	70	240
30	68	71	W36X 135
31	73	72	150
32	82	73	160
33	96	74	170
34	112	75	182
35	127	76	194
36	142	77	230
37	W24X 55	78	245
38	61	79	260
39	68	80	280
40	76	81	300
41	84		

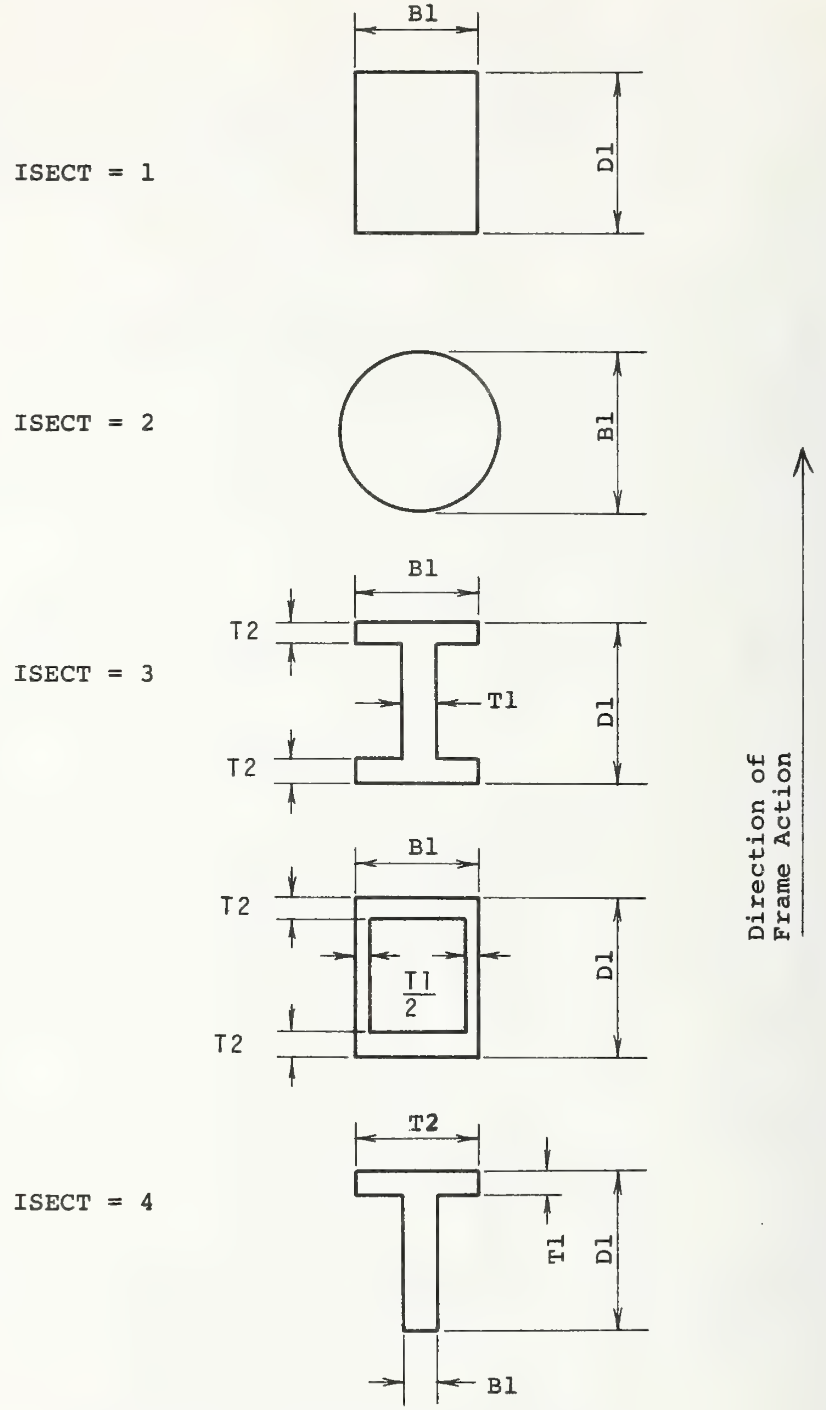


Figure 12. Beam and Column Sections

E: Column Properties Card

The Column Properties card is used to override column properties already included in the data base or to add additional column properties for use in this particular run (refer to Table 6). The total number of cards must equal the number entered for NCT in the Frame Description card. If NØPT = 1, the card contains:

Field No.	Symbolic Code	Description of Contents
1 I	J	Column number; if it is between 1 and 38 or 51 and 88, it overrides corresponding properties in the data base; if it is between 39 and 50 or 89 and 99, it adds additional properties to the data base.
2 F	AC	Area (in.^{2})
3 F	IC	Moment of inertia (in.^{4})
4 F	WC	Weight (lb/ft)

If NØPT = 2, the card contains:

Field No.	Symbolic Code	Description of Contents
1 I	J	Column number
2 F	B1	Column dimension, see Figure 12
3 F	D1 *	Column dimension, see Figure 12
4 I	ISECT	Column section code, see Figure 12
1 F	T1	Column dimension } enter values on next card if ISECT >2
2 F	T2	Column dimension } enter values on next card if ISECT >2

*If ISECT = 2, D1 is not used in computation. However, the column properties card must still contain 4 fields. Either two adjacent commas or a dummy value must be specified.

Table 6. Column Sections Included in Stored Data Base

Column Number		Section
Strong Axis Bending	Weak Axis Bending	
1	51	W14X 61
2	52	68
3	53	74
4	54	W14X 78
5	55	84
6	56	W14X 87
7	57	95
8	58	103
9	59	111
10	60	119
11	61	127
12	62	136
13	63	W14X 142
14	64	150
15	65	158
16	66	167
17	67	176
18	68	184
19	69	193
20	70	202
21	71	211
22	72	219
23	73	228
24	74	237
25	75	W14X 246
26	76	264
27	77	287
28	78	314
29	79	342
30	80	370
31	81	398
32	82	426
33	83	W14X 455
34	84	500
35	85	550
36	86	605
37	87	665
38	88	730

F: <u>Brace Description Card</u>

One Brace Description card is required for each bracing type. A bracing type is associated with a diagonal bay member of a particular cross-sectional area. Any one bracing type may be used repeatedly throughout the frame and is specified by either of the variables BT1 or BT2 which are defined for Card K.

Field No.	Symbolic Code	Description of Contents
1 I	J	Integer numbers identifying bracing type
2 F	ABR (J)	Cross-sectional area of bracing member type J

G: <u>Bay Description Card</u>

One Bay Description card is required for each set of consecutive bays with identical widths. The total number of cards is always less than or equal to the number of bays NB in the Frame Description card. If NØPT = 1, enter only items in fields 1 and 2. If NØPT = 2, enter all four items.

Field No.	Symbolic Code	Description of Contents
1 I	NUM	Number of consecutive bays of identical width
2 F	BW	Bay width
3 F	BL1	Distance to face of column left end of span (see Figure 13)
4 F	AL1	Distance to face of column right end of span (see Figure 13)

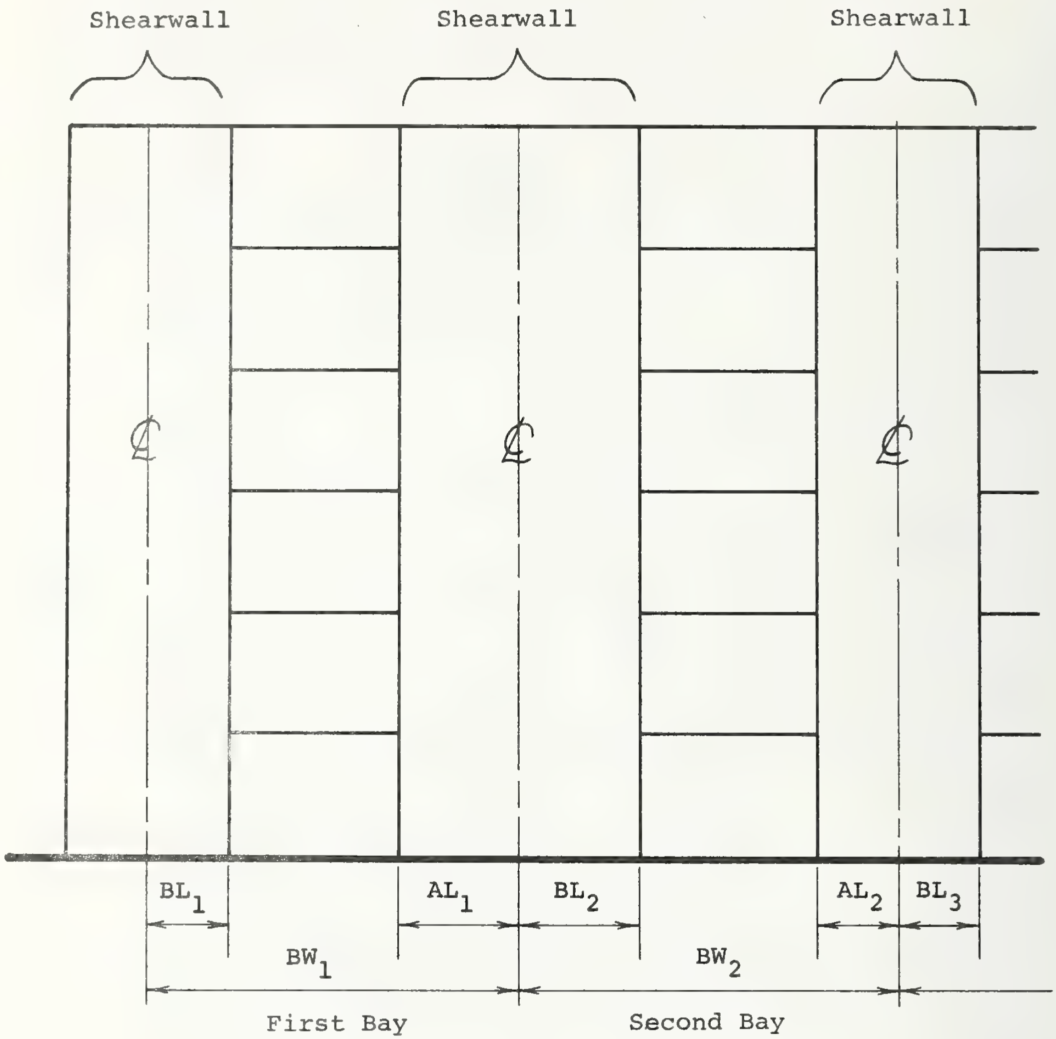


Figure 13. Bay Dimensions for NØPT = 2

H: Story Description Card

One Story Description card is required for each set of consecutive stories with identical height. The total number of cards is always less than or equal to the number of stories indicated in field 3 (NS) of the Control card.

Field No.	Symbolic Code	Description of Contents
1 I	NUM	Number of consecutive stories of identical height
2 F	SH	Story height

I: Beam Card

One Beam card is required for each set of consecutively identical members for each story. The total number of cards per story is always less than or equal to the number of bays. If NØPT = 1 and NRFJ = 1, omit fields 3 through 7. If NØPT = 2, omit fields 3 through 7.

Field No.	Symbolic Code	Description of Contents
1 I	NUM	Number of consecutively identical beams, starting from the left.
2 I	BT	Type of beam from data base (Table 5) or input (Beam Properties card).
3 I	IFR	IFR≠ 1 joints are assumed rigid and the values for SCJ and SCK that are read in are ignored.
4 F	A	Dimension of rigid joint at left end (see Fig. 14).
5 F	B	Dimension of rigid joint at right end (see Fig. 14).
6 F	SCJ	Spring constant left end (see Figure 14).
7 F	SCK	Spring constant right end (see Figure 14).

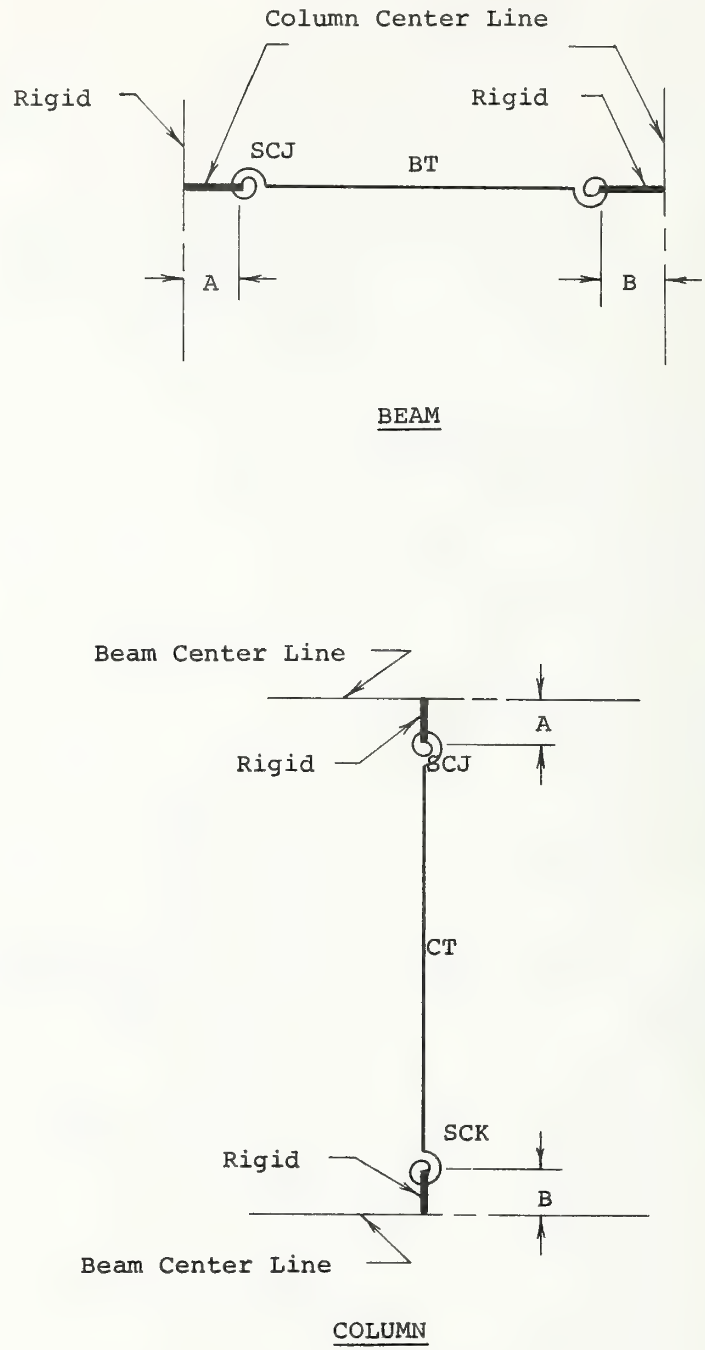


Figure 14. Beam and Column for NØPT = 1

J: Column Card

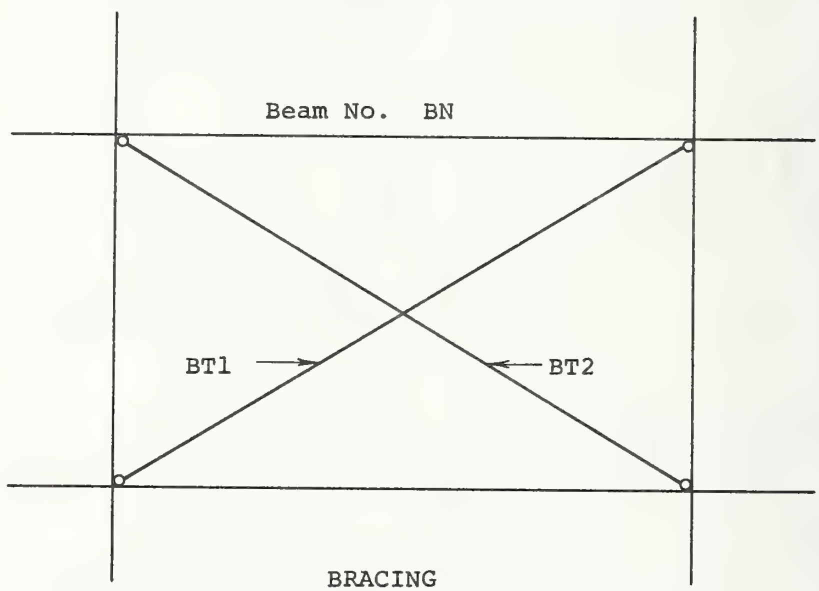
One Column card is required for each set of consecutively identical columns. The total number of Column cards per story is always less than or equal to the number of bays plus 1 (Figure 4). If NØPT = 1 and NRFJ = 1, omit fields 3 through 7. If NØPT = 2, omit fields 3 through 7.

Field No.	Symbolic Code	Description of Contents
1 I	NUM	Number of consecutively identical columns, starting from the left.
2 I	CT	Type of column from data base (Table 6) or input (Column Properties card).
3 I	IFR	IFR=1, joints are assumed rigid and the values for SCJ and SCK that are read in are ignored.
4 F	A	Dimension of rigid joint at top end (see Figure 14).
5 F	B	Dimension of rigid joint at bottom end(see Figure 14).
6 F	SCJ	Spring constant top end (see Figure 14).
7 F	SCK	Spring constant bottom end (see Figure 14).

K: Brace Card

The number of Brace cards is always equal to NBB. Refer to Figure 15 for the orientation of the pair of braces.

Field No.	Symbolic Code	Description of Contents
1 I	BN	Beam number (refer to Figure 11).
2 I	BT1	Brace type for first brace.
3 I	BT2	Brace type for second brace.



Note - K bracing and other bracing systems may be handled by inserting "ficticious" members or members with near zero stiffness.

Figure 15. Braces for NØPT = 1

2.2.2 Level 2 - Story Stiffness Model: Input to Subroutine STIFF2

Card	No. of Cards	Input Variable
A	1	SK(I), I=1, NS
B	1	LC(I), I=1, NS

A: <u>Story Stiffness Card</u>

Story stiffness coefficients are read form this card, top to bottom. These stiffnesses correspond to the springs shown in Figure 2. They need not represent translational stiffnesses of column type structures where both ends of the column are constrained against rotation. Although this is one interpretation, resulting modal frequencies may be too high so that somewhat smaller stiffness coefficients should be used.

Field No.	Symbolic Code	Description of Contents
1 to NS F	SK(I)	Stiffness coefficient for the Ith story

B: <u>Story Height Card</u>

Field No.	Symbolic Code	Description of Contents
1 to NS F	LC(I)	Height of Ith story

2.2.3 Level 3 - Empirical Model: Input to Subroutine STIFF3

Card	No. of Cards	Input Variables
A	1	TI
B	1	LC(I), I=1, NS

A: Fundamental Period

Field No.	Symbolic Code	Description of Contents
1 F	TI	Fundamental Period

B: Story Heights

Field No.	Symbolic Code	Description of Contents
1 to NS F	LC (I)	Height of Ith Story

2.2.4 Floor Weight - Input to Subroutine FLMASS

Card	No. of Cards	Input Variables
A	1	FWT(I), I = 1, NS

A: Floor Weight

Field No.	Symbolic Code	Description of Contents
1 to NS F	FWT (I)	Weight of Ith floor in KIPS

2.3 Response (See Section 3.4 of the main text)

2.3.1 Input to Subroutine DYNAMC

Card	No. of Cards	Input Variables
A	1	NDAMP, ITERMX, LD, MCØP
B	1	DRFTY(I), I=1, NS

A: <u>Option Card</u>

Field No.	Symbolic Code	Description of Contents
1 I	NDAMP	= 1 Damping for steel and reinforced concrete frame structures = 2 Damping for bolted steel frame or timber structures
2 I	ITERMX	Maximum number of iterations allowed to converge on damping and ductility.
3 I	LD	= 0 Do not modify damped response spectrum to account for ductility. ≠ 0 Modify response spectrum for ductility.
4 I	MCØP	Modal Combination Option = 1 First Mode Only = 2 RSS = 3 Sum absolute values

B: <u>Story Drift to Yield</u>

This quantity, Δ_y, is used to compute ductility = Δ/Δ_y and represents the drift of each story at which yielding begins to occur somewhere within the primary structure of that story. The user should input appropriate values according to whether yielding occurs first to frame or structural walls.

Field No.	Symbolic Code	Description of Contents
1 to N F	DRFTY (I)	Interstory drift to yield for each story

2.3.2 Input to Subroutine STATIC , NHAZ(2) ≠ 0

See Section 3.4 of the main text.

Card	No. of Cards	Input Variables
A	1	BS
B	1	ITYPE*, ANGLE (ISHAPE = 1)
C	1	CA, CB, ANGLE (ISHAPE = 2)
D	1	CC, CD (ISHAPE = 2)
E	1	RATIØ, IWALL

*See Table 7 for values of ITYPE for specific building configurations.

A: Ambient Damping for Wind Analysis

Field No.	Symbolic Code	Description of Contents
1 F	BS	Building Damping Under Wind Conditions as a fraction of critical. This value should be less than the damping of the building under strong earthquake conditions.

B. Specification of External Presure Coefficients Using Stored Data

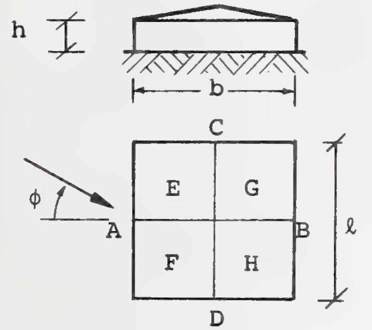
For Use if ISHAPE = 1. See Section 2.1.2, Card A.

Field No.	Symbolic Code	Description of Contents
1 I	ITYPE	Code from Table 7 for specification of building's shape
2 I	ANGLE	Code from Table 8 for specification of wind direction.

Table 7. Building Identification by Code ITYPE Using Swiss and ANSI A58.1 - 1972 Data, External Pressure Coefficients. All Data Are Swiss Unless Otherwise Noted.

ITYPE

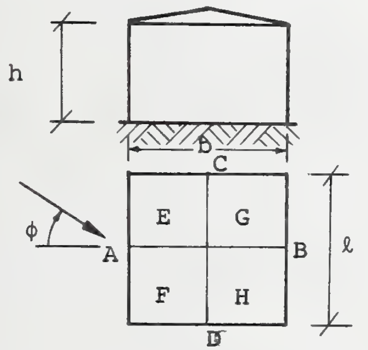
1 Gabled Roofs 0^{o}-3^{o}



$h:b:\ell = 1:4:4$

φ	A	B	C	D	E	F	G	H
0^{o}	.9	-.3	-.4	-.4	-.8	-.8	-.3	-.3
45^{o}	.5	-.4	.5	-.4	-.9	-.6	-.6	-.3
90^{o}	-.4	-.4	.9	-.3	-.8	-.3	-.8	-.3

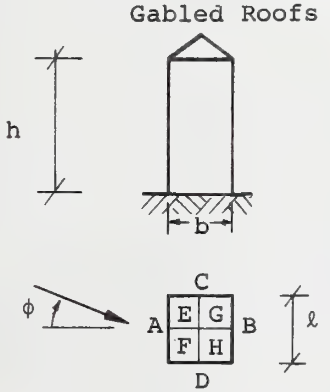
2 Gabled Roofs 0^{o}-10^{o}



$h:b:\ell = 1:1:1$

φ	A	B	C	D	E	F	G	H
0^{o}	.9	-.5	-.6	-.6	-.7	-.7	-.5	-.5
45^{o}	.5	-.5	.5	-.5	-.8	-.5	-.5	-.4
90^{o}	-.6	-.6	.9	-.5	-.7	-.5	-.7	-.5

3 Gabled Roofs 0^{o}-15^{o}



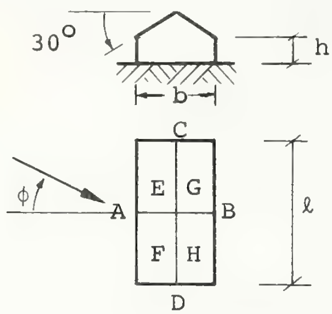
$h:b:\ell = 2.5:1:1$

φ	A	B	C	D	E	F	G	H
0^{o}	.9	-.6	-.7	-.7	-.8	-.8	-.8	-.8
45^{o}	.5	-.5	-.5	-.5	-.8	-.7	-.7	-.5
90^{o}	-.7	-.7	.9	-.6	-.8	-.8	-.8	-.8

Table 7. Building Identification (Continued)

I TYPE

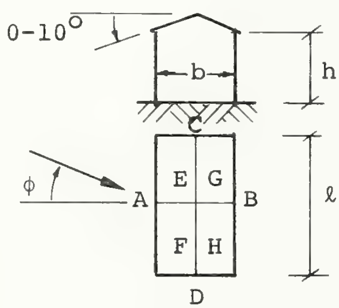
4



h:b:ℓ = 1:8:16

φ	A	B	C	D	E	F	G	H
0°	.8	-.5	-.5	-.5	.2	.2	-.6	-.6
45°	.5	-.5	.4	-.3	.1	-.1	-.8	-.5
90°	-.3	-.3	.9	-.3	-.5	-.1	-.5	-.1

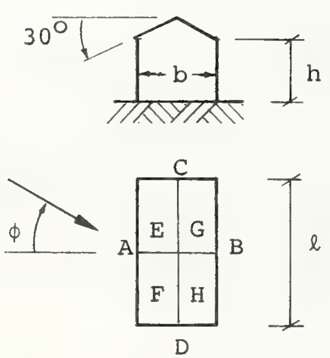
5



h:b:ℓ = 2.5:2:5

φ	A	B	C	D	E	F	G	H
0°	.9	-.5	-.7	-.7	-.6	-.6	-.5	-.5
45°	.6	-.5	.4	-.5	-.9	-.7	-.6	-.7
90°	-.5	-.5	.9	-.4	-.8	-.2	-.8	-.2

6



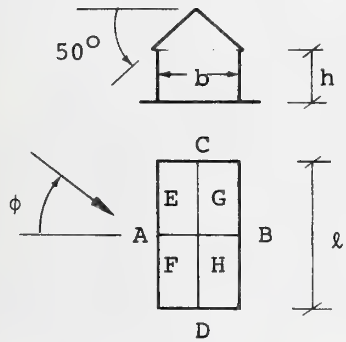
h:b:ℓ = 2.5:2:5

φ	A	B	C	D	E	F	G	H
0°	.9	-.5	-.7	-.7	-.6	-.6	-.5	-.5
45°	.6	-.5	.4	-.4	-.4	-.5	-.6	-.7
90°	-.5	-.5	.9	-.4	-.7	-.2	-.7	-.2

Table 7. Building Identification (Continued)

I TYPE

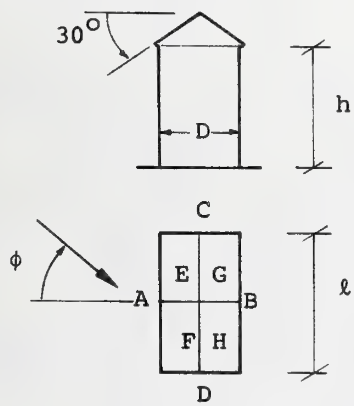
7



h:b:ℓ = 2.5:2:2.5

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.5	-.7	-.8	.3	.3	-.6	-.6
45°	.6	-.5	.4	-.4	.3	-.1	-.5	-.6
90°	-.5	-.5	.9	-.4	-.8	-.2	-.8	-.2

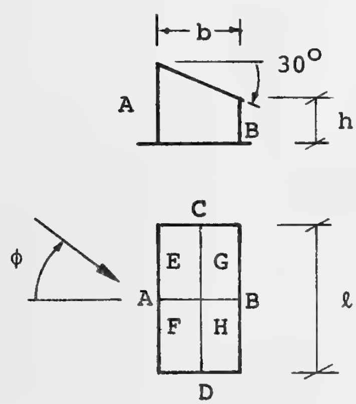
8



h:b:ℓ = 2:1:2

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.5	-.8	-.8	-1.0	-1.0	-.5	-.5
45°	.6	-.5	.4	-.4	-.3	-.4	-.5	-.6
90°	-.6	-.6	.9	-.4	-.7	-.5	-.7	-.5

9



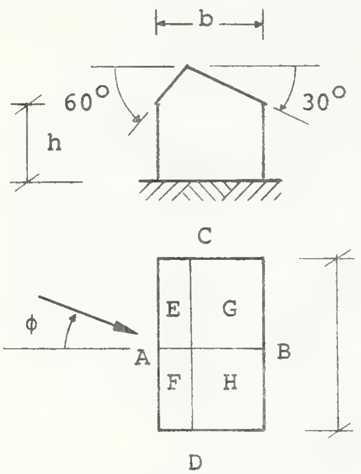
h:b:ℓ = 1:2.4:12

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.5	-.6	-.6	-.5	-.5	-.5	-.5
45°	.5	-.6	.4	-.4	-1.2	-.7	-1.1	-.7
90°	-.4	-.3	.9	-.2	-.3	0	-.3	0

Table 7. Building Identification (Continued)

I TYPE

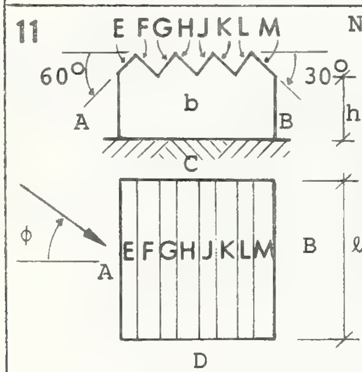
10



$h:b:\ell = 1:1:5$

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.5	-.6	-.6	.6	.6	-.5	-.5
45°	.5	-.8	.4	-.5	.2	-.1	-1.0	-.8
90°	-.4	-.4	.9	-.3	-.4	0	-.4	0

11

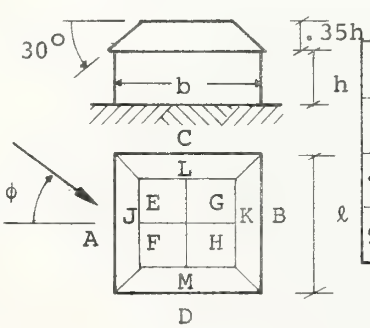


Neglect Wind Friction

$h:b:\ell = 1:4:5$

ϕ	A	B	C	D	E	F	G	H	J	K	L	M
0°	.9	-.3	-.4	-.4	.6	-.6	-.6	-.5	-.5	-.4	-.3	-.3
45°	.5	-.4	.5	-.3	.2	-.8	-.5	-.4	-.2	-.4	-.2	-.5
90°	-.4	-.4	.9	-.3	-.3	-.4	-.4	-.4	-.4	-.4	-.4	-.3

12



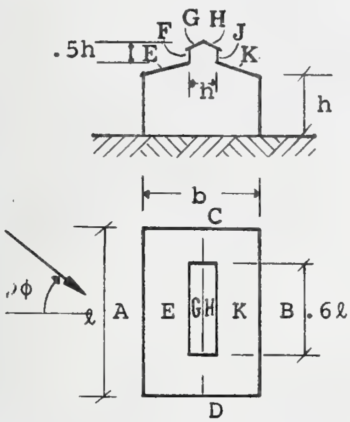
$h:b:\ell = 1:3:4$

ϕ	A	B	C	D	E	F	G	H	J	K	L	M
0°	.9	-.5	-.6	-.6	-.8	-.8	-.4	-.4	-1.0	-.4	.5	-.5
45°	.5	-.5	.5	-.4	-.6	-.5	-.5	-.5	-.5	-.5	-.5	-.5
90°	-.5	-.5	.9	-.4	-.8	-.4	-.8	-.4	-.4	-.4	-1.0	-.4

Table 7. Building Identification (Continued)

I TYPE

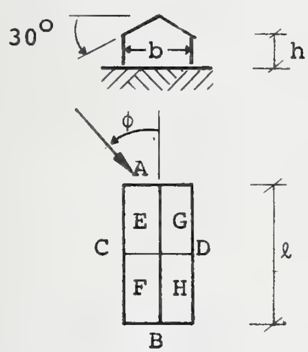
13



$h:b:\ell = 1:4:8$

ϕ	A	B	C	D	E	F	G	H	J	K
0°	.8	-.5	-.7	-.7	.2	.6	-1.0	-.6	-.5	-.6
45°	.4	-.5	.4	-.5	-.3	.2	-1.3	-1.4	-1.0	-.7
90°	-.4	-.4	.8	-.3	-.4	-.2	-.3	-.3	-.2	-.4

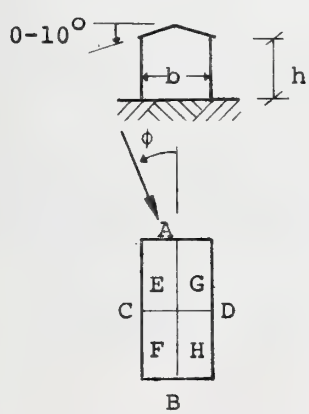
14



$h:b:\ell = 1:8:16$

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.3	-.3	-.3	-.5	-.1	-.5	-.1
45°	.4	-.3	.5	-.5	.1	-.1	-.8	-.5
90°	-.5	-.5	.8	-.5	.2	.2	-.6	-.6

15



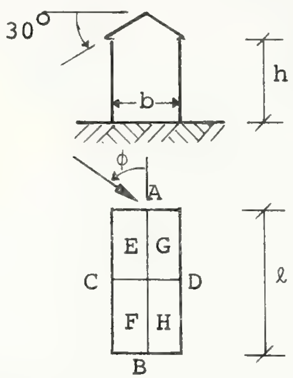
$h:b:\ell = 2.5:2:5$

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.4	-.5	-.5	-.8	-.2	-.8	-.2
45°	.4	-.5	.6	-.5	-.9	-.7	-.6	-.7
90°	-.7	-.7	.9	-.5	-.6	-.6	-.5	-.5

Table 7. Building Identification (Continued)

I TYPE

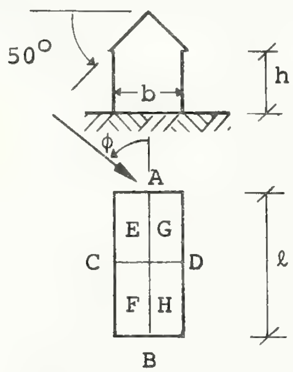
16



$h:b:\ell = 2.5:2:5$

φ	A	B	C	D	E	F	G	H
0°	.9	-.4	-.5	-.5	-.7	-.2	-.7	-.2
45°	.4	-.4	.6	-.5	-.4	-.5	-.6	-.7
90°	-.7	-.7	.9	-.5	-.6	-.6	-.5	-.5

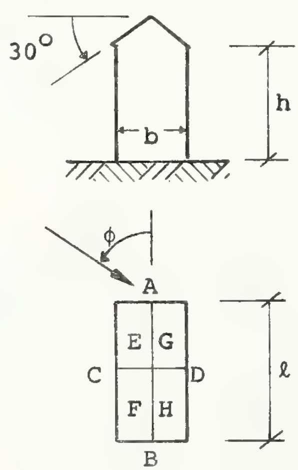
17



$h:b:\ell = 2.5:2:5$

φ	A	B	C	D	E	F	G	H
0°	.9	-.4	-.5	-.5	-.8	-.2	-.8	-.2
45°	.4	-.4	.6	-.5	.3	-.1	-.5	-.6
90°	-.8	-.8	.9	-.5	.3	.3	-.6	-.6

18



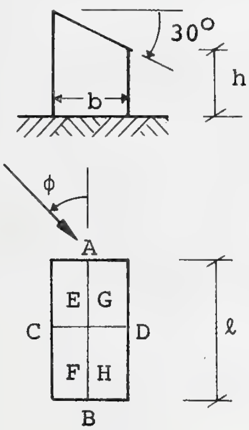
$h:b:\ell = 2:1:2$

φ	A	B	C	D	E	F	G	H
0°	.9	-.4	-.6	-.6	- .7	- .5	-.7	-.5
45°	.4	-.4	.6	-.5	- .3	- .4	-.5	-.6
90°	-.8	-.8	.9	-.5	-1.0	-1.0	-.5	-.5

Table 7. Building Identification (Continued)

I TYPE

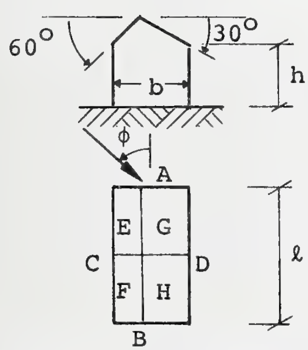
19



$h:b:\ell = 1:2.4:12$

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.2	-.4	-.3	- .3	0	- .3	0
45°	.4	-.4	.5	-.6	-1.2	-.7	-1.1	-.7
90°	-.6	-.6	.9	-.5	- .5	-.5	- .5	-.5

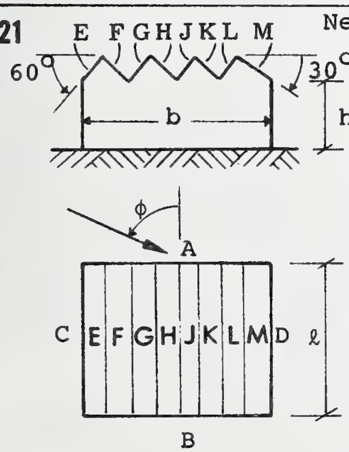
20



$h:b:\ell = 1:1:5$

ϕ	A	B	C	D	E	F	G	H
0°	.9	-.3	-.4	-.4	-.4	0	- .4	0
45°	.4	-.5	.5	-.8	.2	-.1	-1.0	-.8
90°	-.6	-.6	.9	-.5	.6	.6	- .5	-.5

21



Neglect Wind Friction

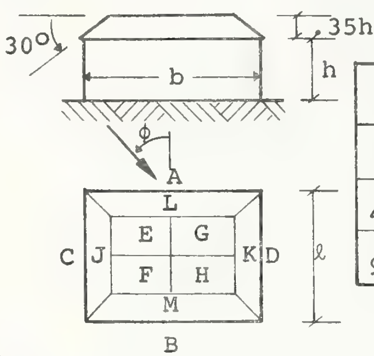
$h:b:\ell = 1:4:5$

ϕ	A	B	C	D	E	F	G	H	J	K	L	M
0°	.9	-.3	-.4	-.4	-.3	-.4	-.4	-.4	-.4	-.4	-.4	-.3
45°	.5	-.3	.5	-.4	.2	-.8	-.5	-.4	-.2	-.4	-.2	-.5
90°	-.4	-.4	.9	-.3	.6	-.6	-.6	-.5	-.5	-.4	-.3	-.3

Table 7. Building Identification (Continued)

I TYPE

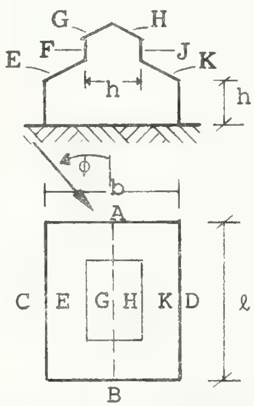
22



$h:b:\ell = 1:3:4$

ϕ	A	B	C	D	E	F	G	H	J	K	L	M
0°	.9	-.4	-.5	-.5	-.8	-.4	-.8	-.4	-.4	-.4	-1.0	-.4
45°	.5	-.4	.5	-.5	-.6	-.5	-.5	-.5	-.5	-.5	-.5	-.5
90°	-.6	-.6	.9	-.5	-.8	-.8	-.4	-.4	-1.0	-.4	-.5	-.5

23

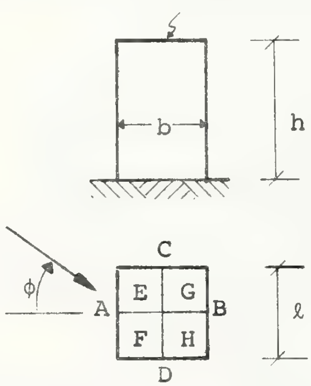


$h:b:\ell = 1:4:8$

ϕ	A	B	C	D	E	F	G	H	J	K
0°	.8	-.3	-.4	-.4	-.4	-.2	-.3	-.3	-.2	-.4
45°	.4	-.5	.4	-.5	-.3	.2	-1.3	-1.4	-1.0	-.7
90°	-.7	-.7	.8	-.5	-.2	.6	-1.0	-.6	-.5	-.6

24

Essentially Flat



$h:b:\ell = 1:\geq 2.5:\geq 2.5$

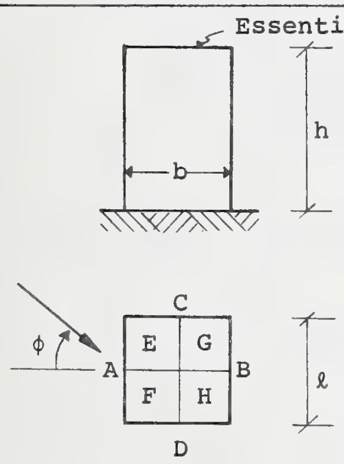
ϕ	A	B	C	D	E	F	G	H
0°	.8	-.6	-.7	-.7	-.8	-.8	-.8	-.8
90°	-.7	-.7	.8	-.6	-.8	-.8	-.8	-.8

ANSI A58.1 - 1972
(No Specifications for $\phi = 45°$)

Table 7. Building Identification (Continued)

I TYPE

25



$h:b:\ell = 1:<2.5:<2.5$

ϕ	A	B	C	D	E	F	G	H
0°	.8	-.5	-.7	-.7	-.7	-.7	-.7	-.7
90°	-.7	-.7	.8	-.5	-.7	-.7	-.7	-.7

ANSI A58.1 - 1972
(No Specification for $\phi = 45^{\circ}$)

Table 8. Codes for Specification of Wind Direction With Respect to Line of Frame Action

ANGLE	Direction
1	0°
2	45°
3	90°

C: <u>User Specification of External Pressure Coefficients For Frame Action Analysis</u>.

For use if ISHAPE = 2. See Section 2.1.2, Card A.

Field No.	Symbolic Code	Description of Contents
1 F	CA	Pressure coefficient for windward wall for frame action analysis. See Fig. 16, Wall 1
2 F	CB	Presure coefficient for leeward wall for frame action analysis. See Fig. 16, Wall 2
3 I	ANGLE	Code for wind direction with respect to line of frame action. Table 8.

D: <u>User Specification of External Pressure Coefficients for Window Damage Estimates for Side Wall, i.e., Walls Parallel to Line of Frame Action</u>.

Field No.	Symbolic Code	Description of Contents
1 F	CC	External Pressure Coefficient for Wall 3. See Fig. 16.
2 F	CD	External Pressure coefficient for Wall 4. See Fig. 16.

E: <u>Window Damage Due to Wind Data</u>.

Field No.	Symbolic Code	Description of Contents
1 F	RATIO	Ratio of open area to solid area 0.≤ ratio ≤ 1.
2 I	IWALL	Wall code specifying which exterior wall has the majority of openings. =1 Wall 1 See Fig. 16 =2 Wall 2 See Fig. 16 =3 Wall 3 See Fig. 16 =4 Wall 4 See Fig. 16 =5 Openings uniformly distributed.

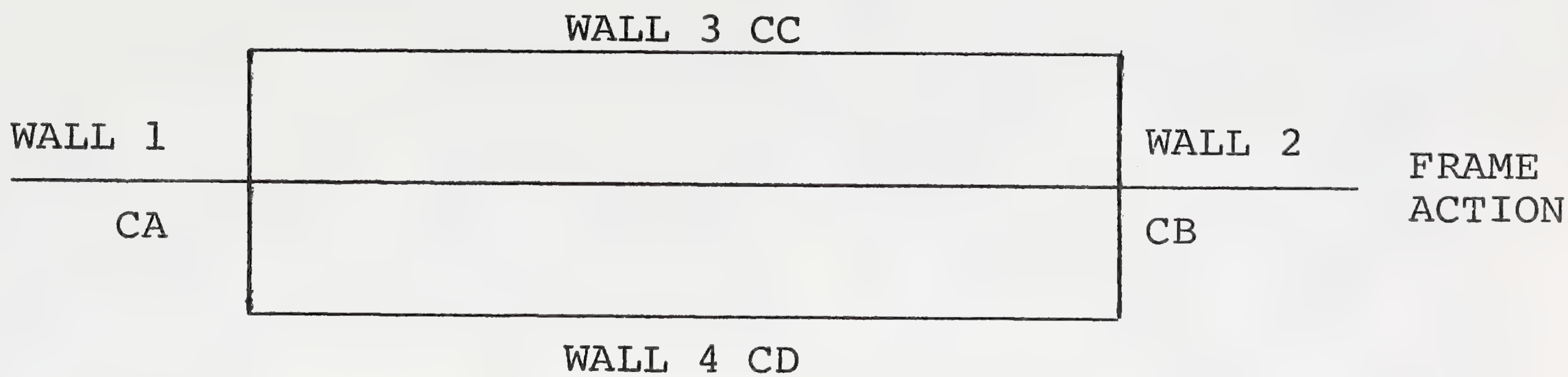


Figure 16. Wall Numbering Convention With Respect to Line of Frame Action

2.3.3 Input to Subroutine LSRØØF

Cards	No. of Cards	Input Variables
A	1	TYPEA, ALPHA, VL, CL, DØP, NP+
B	1	VECTOR(I)++, I=1, NP (TYPEA = 3)

\+ Set NP=0 only if TYPEA ≠ 3

++ See Table 7 for User Input Options to VECTOR(I)

A: <u>Long Span Roof Data Card</u>

Field No.	Symbolic Code	Description of Contents
1 I	TYPEA	Analysis Type Code = 1 General Swiss Approach* = 2 ANSI Specifications* = 3 Detailed Analysis, User inputs roof pressure coefficients
2 F	ALPHA	Slope of Roof in <u>Degrees</u>
3 F	VL	Roof uplift resistance capacity in <u>pounds</u>. Dead weight and connection capacities to vertical uplift.
4 F	CL	Collapse Capacity of walls in <u>pounds</u>
5 F	DØP	Depth Of Ponding in <u>Feet</u>
6 I	NP	Number of data points to be read for detailed analysis. If TYPEA ≠ 3, some value must be input, say Zero (0).

---

*Roof pressure coefficients are generated internally for TYPEA = 1 and TYPEA = 2.

B: External Pressure Coefficients (TYPEA = 3 only)

Field No.	Symbolic Code	Description of Contents
1 to NP F	VECTOR (I)	VECTOR(I) contains roof external pressure coefficients. Suggested values are presented in Table 7. Starting with data in column E = VECTOR (1) F = VECTOR (2), etc. through H or M, depending on structure selected.

2.4 Damage

2.4.1 Input to Subroutine DAMAG for either Earthquake, Wind, Tornado, or any Combination of the Three.

Card	No. of Cards	Input Variables	
A1	1	DELTY (I,1), I=1, NS	Frame
B1	1	CVDY (I,1), I=1, NS	
A2	1	DELTY (I,2), I=1, NS	Walls
B2	1	CVDY (I,2), I=1, NS	
A3	1	DELTY (I,3), I=1, NS	Diaphragms
B3	1	CVDY (I,3), I=1, NS	
C	1	HW(I), I=1, NS	
D	1	BW(I), I=1, NS	

A1: Interstory Drift to Yield - Frame

Field No.	Symbolic Code	Description of Contents
1 to NS F	DELTY (I,1)	Interstory drift to yield See Methodology Report for empirical data.

B1: Coefficients of Variation - Frame

Field No.	Symbolic Code	Description of Contents
1 to NS F	CVDY (I,1)	Coefficient of Variation on DELTY (I,1)

A2: Interstory Drift to Yield - Walls

See B1 above for description.

B2: Coefficients of Variation - Walls

See C2 above for description.

A3: Interstory Drift to Yield - Diaphragms

See B1 above for description.

B3: Coefficients of Variation - Diaphragms

See C1 above for description.

C: Height of Windows

Field No.	Symbolic Code	Description of Contents
1 to NS F	HW (I)	Nominal window height

D: Width of Windows

Field No.	Symbolic Code	Description of Contents
1 to NS F	BW (I)	Nominal window width

2.4.2 Additional Input to Subroutine DAMAG for Earthquake Only

Card	No. of Cards	Input Variables	
A1	1	DMUF (I, 1) I=1, NS	Frame
B1	1	CVDMUF (I, 1) I=1, NS	
A2	1	DMUF (I, 2) I=1, NS	Walls
B2	1	CVDMUF (I, 2) I=1, NS	
A3	1	DMUF (I, 3) I=1, NS	Diaphragms
B3	1	CVDMUF (I, 3) I=1,NS	
C	1	Q (I) I=1, NS	
D	1	DC (I) I=1, NS	
E	1	CVDLTG(I) I=1, NS	

A1: <u>Ductility to Failure - Frame</u>

Field No.	Symbolic Code	Description of Contents
1 to NS F	DMUF(I,1)	Ductility to failure for structural frame. Section 3.4 of the main text for data.

B1: <u>Coefficient of Variation on DMUF - Frame</u>

Field No.	Symbolic Code	Description of Contents
1 to NS F	CVDMUF(I,1)	Coefficient of variation on DMUF(I,1)

A2: <u>Ductility to Failure - Walls</u>

See A1 above for description.

B2: Coefficient of Variation on DMUF - Walls

See B1 above for description.

A3: Ductility to Failure - Diaphragms

See A1 above for description.

B3: Coefficient of Variation on DMUF - Diaphragms

See B1 above for description.

C: Quality Factor of Nonstructural Materials

Field No.	Symbolic Code	Description
1 to NS F	Q(I)	= 1 Poor quality = 2 Minimum code quality = 3 Superior quality

D: Mullion Clearance

Field No.	Symbolic Code	Description
1 to NS F	DC(I)	Average clearance in mullions for nominal windows

E: Coefficient of Variation on Mullion Clearance

Field No.	Symbolic Code	Description
1 to NS F	CVDLTG(I)	Coefficient of variation on DC(I)

2.4.3 Additional Input to Subroutine DAMAG for Wind Only.

Card	No. Cards	Input Variables
A	1	DELTYP (I) I=1, NS
B	1	CVDYP (I) I=1, NS
C	1	THG (I) I=1, NS
D	1	SGB
E	1	CVPZR (I) I=1, NS

A: Interstory Drift to Yield

Field No.	Symbolic Code	Description
1 to NS F	DELTYP(I)	Interstory drift to yield (for nonstructural partitions) caused by wind loads.

B: Coefficients of Variation - Partition

Field No.	Symbolic Code	Description
1 to NS F	CVDYP(I)	Coefficient of variation on DELTYP(I)

C: Thickness of Glass

Field No.	Symbolic Code	Description
1 to NS F	THG(I)	Thickness of glass used in nominal windows

D: Breaking Stress of Glass

The only failure mode considered is the overstressing of glass due to direct pressure. Failure of window supports is not considered.

Field No.	Symbolic Code	Description of Contents
1 F	SGB	Breaking stress of glass (psi)

E: Coefficients of Variation on Breaking Pressure

Field No.	Symbolic Code	Description of Contents
1 to NS F	CVPZR (I)	Coefficient of variation on the breaking pressure for nominal windows

3.0 OUTPUT DESCRIPTION

Printed output is generated by the computer program. Generally, speaking, the output has been chosen to indicate which data have been read into the program, to display the primary output from loads, structural modeling, response and damage computations, and to display certain intermediate results which are helpful in interpreting the primary output. A brief discussion of output from the four major parts of the program is given in the following paragraphs, followed by a sample listing.

3.1 Loads Output

For earthquake loads the program prints out input data, the Richter Magnitude of the selected earthquake and its effective hypocentral distance from the site. Hard rock acceleration, velocity and displacement are also printed. Soils data selected as input by the user are printed next, followed by the ground velocity spectrum.

For wind loads the program prints out input data, statistical data generated by the regression analysis based on Thom's maps which includes a mean return wind velocity for specified life and probability or return period, and a standard deviation. In case the risk option is bypassed, the user input wind velocity is printed.

For tornado loads the program prints out input data on the probability of strike for the site location. If a tornado wind velocity is specified (ITØR = 1), it too is printed.

3.2 Structural Modeling Output

The program will print out all of the modeling data either input or selected from internal storage. However, the user may suppress portions of the printout by setting NØPRT = 1, in which case detailed framing data are not printed. This option is particularly useful when operating the program from a remote terminal where printed output is time consuming and costly. Gross modeling characteristics such as exterior geometry, number of stories, frames, and bays per frame are output. A stiffness matric, weight vector, and modal matrix are printed in any case.

3.3 Response Output

Input data read in this part of the program are printed. In the iterative loop of DYNAMC where damping and ductility are being computed, these quantities are output along with modal parameters and their corresponding spectral velocities. This output is helpful in establishing the sensitivity of response to these parameters. If the NØPRT option is not used (NØPRT ≠ 1), additional modal data are printed and story forces and shears are printed for each of the three modal combination options. The latter information is useful in illustrating the range of total response obtainable by selecting among the various options.

Output from STATIC consists of story drift and shears due to wind pressure forces. The same output is provided for both wind and tornado.

3.4 Damage Output

Output from DAMAG includes all of the damagiability data input by the user as well as the results of damage computations for earthquake, wind and tornado -- structural, non-structural and glass. This output is given story by story. In the case of nonstructural damage due to earthquake, the values of Modified Mercalli Intensity which form the basis of damage computations are also printed out.

Damage to long-span roofs is simply indicated by a fail or no fail type statement for each of the two modes of failure--separation and collapse.

FURPUR   T25-09/28-16:16
HASSELMAN-T*NBSF.BX10

```
BRANDOW EXAMPLE 10
1,0,0
34.2,118.5
1,1,0
1
50.,.5
5.209,.350,50.
1.,8.5
0
3,1.0
2,1
2,40.0
6,600.,300.,0.,0
1
2
2,1,2,3800.,1520.,2100.,840.,0.,0.,0
1,12.,28.,4
5.,48.
1,18.,18.,1
2,8.,160.,1
1,480.,9.,80.
1,480.,80.,9.
6,144.
2,1
1,1
1,2
1,1
2,1
1,1
1,2
1,1
2,1
1,1
1,2
1,1
2,1
1,1
1,2
1,1
2,1
1,1
1,2
1,1
2,1
1,1
1,2
1,1
1000.,1000.,1000.,1000.,1000.,1000.
1,6,1,2
.013,.013,.013,.013,.013,.013
.013,.013,.013,.013,.013,.013
.25,.25,.25,.25,.25,.25
.013,.013,.013,.013,.013,.013
.25,.25,.25,.25,.25,.25
.013,.013,.013,.013,.013,.013
.25,.25,.25,.25,.25,.25
60.,60.,60.,60.,60.,60.
60.,60.,60.,60.,60.,60.
18.,18.,18.,18.,18.,18.
```

```
.25,.25,.25,.25,.25,.25
11.,11.,11.,11.,11.,11.
.25,.25,.25,.25,.25,.25
11.,11.,11.,11.,11.,11.
.25,.25,.25,.25,.25,.25
3.,3.,3.,3.,3.,3.
.25,.25,.25,.25,.25,.25
.25,.25,.25,.25,.25,.25
```

```
@XQT   GOGO                           SAMPLE OUTPUT LISTING                       PAGE 1/10
@ADD,P   NBSF.BX10
@ADD,P   NBSF.BX10
RUN IDENTIFICATION:
          BRANDOW EXAMPLE 10
INCLUDE EARTHQUAKE HAZARD:   1
INCLUDE WIND HAZARD:         0
INCLUDE TORNADO HAZARD:      0
SITE LOCATION: LATITUDE   34.20  DEGREES, LONGITUTE  118.50  DEGREES
EXERCISE RISK OPTION:        1
BUILDING MODELING OPTION:      1
EVALUATE DAMAGE TO LONG-SPAN ROOF:     0

                    E A R T H Q U A K E   L O A D   A N A L Y S I S

MEAN SEISMICITY   =   5.209+00     STANDARD DEVIATION = 3.500-01
PROBABILITY THAT EARTHQUAKE OF MAGNITUDE  7.9
OR LARGER WILL NOT OCCUR DURING A PERIOD OF   50.0 YEARS =  .500
SELECTED SEISMICITY:  MEAN PLUS  1.0  SIGMA =  5.6
HARD ROCK GROUND MOTION CHARACTERISTICS

          RICHTER MAGNITUDE            =   8.24+00
          HYPOCENTRAL DISTANCE (MILES)=   5.00+01
          HARD ROCK ACCELERATION (G)  =   8.31-02
          HARD ROCK VELOCITY (IN/SEC) =   4.27+00
          HARD ROCK DISPLACEMENT (IN) =   1.28+00

               DEPTH TO WATER TABLE =   40.00
               SOIL CODE. . . . . . =       2
               BASE SPECTRUM IN TERMS OF THE MEAN AND 1.00 STANDARD DEVIATIONS

          PERIOD (SEC)    .10    .20    .30    .40    .50    .60    .70    .80    .90   1.00
          PSV (IN/SEC)   2.06   4.13   6.19   8.25  10.31  12.38  14.44  16.50  17.28  17.28

          PERIOD (SEC)   1.10   1.20   1.30   1.40   1.50   1.60   1.70   1.80   1.90   2.00
          PSV (IN/SEC)  17.28  17.28  17.28  17.28  17.28  17.28  17.28  17.28  17.11  16.26
```

PERIOD (SEC)	2.10	2.20	2.30	2.40	2.50	2.60	2.70	2.80	2.90	3.00
PSV (IN/SEC)	15.48	14.78	14.14	13.55	13.01	12.51	12.04	11.61	11.21	10.84
PERIOD (SEC)	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90	4.00
PSV (IN/SEC)	10.49	10.16	9.85	9.56	9.29	9.03	8.79	8.56	8.34	8.13
PERIOD (SEC)	4.10	4.20	4.30	4.40	4.50	4.60	4.70	4.80	4.90	5.00
PSV (IN/SEC)	7.93	7.74	7.56	7.39	7.23	7.07	6.92	6.77	6.64	6.50
PERIOD (SEC)	5.10	5.20	5.30	5.40	5.50	5.60	5.70	5.80	5.90	6.00
PSV (IN/SEC)	6.38	6.25	6.13	6.02	5.91	5.81	5.70	5.61	5.51	5.42
PERIOD (SEC)	6.10	6.20	6.30	6.40	6.50	6.60	6.70	6.80	6.90	7.00
PSV (IN/SEC)	5.33	5.24	5.16	5.08	5.00	4.93	4.85	4.78	4.71	4.64
PERIOD (SEC)	7.10	7.20	7.30	7.40	7.50	7.60	7.70	7.80	7.90	8.00
PSV (IN/SEC)	4.58	4.52	4.45	4.39	4.34	4.28	4.22	4.17	4.12	4.06
PERIOD (SEC)	8.10	8.20	8.30	8.40	8.50	8.60	8.70	8.80	8.90	9.00
PSV (IN/SEC)	4.01	3.97	3.92	3.87	3.83	3.78	3.74	3.69	3.65	3.61
PERIOD (SEC)	9.10	9.20	9.30	9.40	9.50	9.60	9.70	9.80	9.90	10.00
PSV (IN/SEC)	3.57	3.53	3.50	3.46	3.42	3.39	3.35	3.32	3.28	3.25

S T R U C T U R A L   A N A L Y S I S

```
NUMBER OF STORIES =     6
TOTAL BUILDING WIDTH (INCHES) =  600.0
TOTAL BUILDING LENGTH (INCHES) =  300.0
HEIGHT OF PARAPET (INCHES)    =     .0
NUMBER OF FRAMES  =      1
*** FRAME NO.  1 ***  FRAME MODELING OPTION =   2
NUMBER OF BAYS  =     2
BEAMS&    E=   2100.0  G=   840.0  W(LBS/CU.FT)=   .00
COLUMNS&  E=   3800.0  G=  1520.0  W(LBS/CU.FT)=   .00
BEAM TYPE       AB        IB         FB
        1     516.0    37827.9       1.54
```

```
COLUMN TYPE          AC           IC          FC
        1          324.0        8748.0        1.20
        2         1280.0     2730666.7        1.20
BAY WIDTHS ------
     1 BAYS AT  480.000 INCHES
     1 BAYS AT  480.000 INCHES
STORY HEIGHTS -------
     6 STORIES AT  144.000 INCHES
STORY NO.      1 -------STRUCTURE DATA
BEAM    AREA          IZ      W(DL)      BL1      AL1
   1      516.0    37827.9    .00000     9.00    80.00
   2      516.0    37827.9    .00000    80.00     9.00
COLUMN  AREA          IZ      W(DL)
   1      324.0     8748.0    .00000
   2     1280.0  2730666.7    .00000
   3      324.0     8748.0    .00000
TOTAL WEIGHT OF STORY FRAMING =          .000 KIPS
STORY NO.      2 -------STRUCTURE DATA
BEAM    AREA          IZ      W(DL)      BL1      AL1
   1      516.0    37827.9    .00000     9.00    80.00
   2      516.0    37827.9    .00000    80.00     9.00
COLUMN  AREA          IZ      W(DL)
   1      324.0     8748.0    .00000
   2     1280.0  2730666.7    .00000
   3      324.0     8748.0    .00000
TOTAL WEIGHT OF STORY FRAMING =          .000 KIPS
STORY NO.     3 -------STRUCTURE DATA
BEAM    AREA          IZ      W(DL)      BL1      AL1
   1      516.0    37827.9    .00000     9.00    80.00
   2      516.0    37827.9    .00000    80.00     9.00
COLUMN  AREA          IZ      W(DL)
   1      324.0     8748.0    .00000
   2     1280.0  2730666.7    .00000
   3      324.0     8748.0    .00000
TOTAL WEIGHT OF STORY FRAMING =          .000 KIPS
STORY NO.     4 -------STRUCTURE DATA
BEAM    AREA          IZ      W(DL)      BL1      AL1
   1      516.0    37827.9    .00000     9.00    80.00
   2      516.0    37827.9    .00000    80.00     9.00
```

THIS OUTPUT IS OMITTED
WHENEVER NOPRT = 1

```
COLUMN   AREA        IZ       W(DL)
   1      324.0    8748.0     .00000
   2     1280.0  2730666.7    .00000
   3      324.0    8748.0     .00000
TOTAL WEIGHT OF STORY FRAMING =          .000 KIPS
STORY NO.    5 -------STRUCTURE DATA
BEAM     AREA        IZ       W(DL)   BL1      AL1
   1      516.0   37827.9     .00000   9.00    80.00
   2      516.0   37827.9     .00000  80.00     9.00
COLUMN   AREA        IZ       W(DL)
   1      324.0    8748.0     .00000
   2     1280.0  2730666.7    .00000
   3      324.0    8748.0     .00000
TOTAL WEIGHT OF STORY FRAMING =          .000 KIPS
STORY NO.    6 -------STRUCTURE DATA
BEAM     AREA        IZ       W(DL)   BL1      AL1
   1      516.0   37827.9     .00000   9.00    80.00
   2      516.0   37827.9     .00000  80.00     9.00
COLUMN   AREA        IZ       W(DL)
   1      324.0    8748.0     .00000
   2     1280.0  2730666.7    .00000
   3      324.0    8748.0     .00000
TOTAL WEIGHT OF STORY FRAMING =          .000 KIPS
STIFFNESS MATRIX (KIPS/IN)
   3.07+03  -5.49+03   2.16+03   2.28+02   2.76+01   3.23+00
  -5.49+03   1.30+04  -9.48+03   1.73+03   1.77+02   2.21+01
   2.16+03  -9.48+03   1.47+04  -9.30+03   1.75+03   1.82+02
   2.28+02   1.73+03  -9.30+03   1.47+04  -9.30+03   1.77+03
   2.76+01   1.77+02   1.75+03  -9.30+03   1.47+04  -9.12+03
   3.23+00   2.21+01   1.82+02   1.77+03  -9.12+03   1.64+04
TOTAL WEIGHT VECTOR (KIPS)
   1.00+03
   1.00+03
   1.00+03
   1.00+03
   1.00+03
   1.00+03
```

THIS OUTPUT IS OMITTED
WHENEVER NOPRT = 1

CHARACTERISTIC VECTORS

1.00+00	-9.45-01	6.97-01	-4.63-01	3.24-01	-1.56-01
8.02-01	-5.28-02	-5.86-01	8.65-01	-9.08-01	5.42-01
5.95-01	6.78-01	-8.61-01	6.51-02	8.58-01	-8.84-01
3.90-01	1.00+00	7.49-02	-9.33-01	-3.95-03	1.00+00
2.04-01	8.38-01	1.00+00	1.50-01	-8.25-01	-8.78-01
6.36-02	3.71-01	8.06-01	1.00+00	1.00+00	5.81-01

E A R T H Q U A K E   R E S P O N S E   A N A L Y S I S

DAMPING CURVE OPTION = 1
MAXIMUM NUMBER ITERATIONS = 6
MODIFY RESPONSE FOR DUCTILITY = 1
MODAL COMBINATION OPTION = 2
EFFECTIVE INTERSTORY DRIFT TO YIELD BY STORY (IN/IN)
1.30-02 1.30-02 1.30-02 1.30-02 1.30-02 1.30-02
CRITICAL DAMPING (PERCENT) = 6.62

MODE NO.	FREQUENCY (CPS)	PERIOD (SEC.)	MASS RATIO	PSUDO-SPECTRAL VELOCITY	MAXIMUM BASE SHEAR	AMPLITUDE RATIO	PS.SPECT.VEL. MODIFIED FOR DUCTILITY (ACCEL)	(DISPL)
1	.6931	1.443	.708	28.288	1355.170	.719	28.288	28.288
2	3.0505	.328	.186	11.710	648.583	1.692	11.710	11.710
3	7.0559	.142	.066	3.647	166.179	2.850	3.647	3.647
4	10.0000	.100	.027	2.063	54.839	4.183	2.063	2.063
5	10.0000	.100	.010	2.063	19.851	7.520	2.063	2.063
6	10.0000	.100	.002	2.063	4.408	15.622	2.063	2.063

THIS OUTPUT IS OMITTED
WHENEVER NOPRT = 1

EFFECTIVE FORCE FOR MODE NO. 1

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	443.734	443.734	9.0406	1.7916	39.3700	.4437
2	355.797	799.531	7.2490	1.8706	31.5679	.3558
3	263.982	1063.514	5.3784	1.8562	23.4216	.2640
4	172.878	1236.391	3.5222	1.6773	15.3385	.1729
5	90.550	1326.941	1.8449	1.2697	8.0340	.0905
6	28.229	1355.170	.5751	.5751	2.5046	.0282

EFFECTIVE FORCE FOR MODE NO. 2

STORY FORCE (KIPS) SHEAR (KIPS) DEFLECTION STORY DRIFT VELOCITY ACCELERATION

1	-324.573	-324.573	-.3414	.3223	-6.5432	-.3246
2	-18.112	-342.685	-.0191	.2640	-.3651	-.0181
3	232.869	-109.816	.2449	.1162	4.6945	.2329
4	343.331	233.516	.3611	.0586	6.9213	.3433
5	287.604	521.120	.3025	.1684	5.7979	.2876
6	127.463	648.583	.1341	.1341	2.5696	.1275

EFFECTIVE FORCE FOR MODE NO. 3

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	102.372	102.372	.0201	.0370	.8922	.1024
2	-86.023	16.349	-.0169	.0079	-.7497	-.0860
3	-126.367	-110.018	-.0248	.0270	-1.1013	-.1264
4	11.001	-99.018	.0022	.0267	.0959	.0110
5	146.847	47.830	.0289	.0056	1.2798	.1468
6	118.349	166.179	.0233	.0233	1.0315	.1183

EFFECTIVE FORCE FOR MODE NO. 4

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	-37.144	-37.144	-.0036	.0104	-.2284	-.0371
2	69.391	32.247	.0068	.0063	.4267	.0694
3	5.219	37.466	.0005	.0078	.0321	.0052
4	-74.830	-37.364	-.0073	.0085	-.4602	-.0748
5	12.017	-25.347	.0012	.0067	.0739	.0120
6	80.186	54.839	.0078	.0078	.4931	.0802

EFFECTIVE FORCE FOR MODE NO. 5

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	14.449	14.449	.0014	.0054	.0889	.0144
2	-40.509	-26.061	-.0040	.0077	-.2491	-.0405
3	38.280	12.219	.0037	.0038	.2354	.0383
4	-.176	12.043	-.0000	.0036	-.0011	-.0002
5	-36.799	-24.756	-.0036	.0080	-.2263	-.0368
6	44.607	19.851	.0044	.0044	.2743	.0446

EFFECTIVE FORCE FOR MODE NO. 6

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	-3.352	-3.352	-.0003	.0015	-.0206	-.0034
2	11.635	8.283	.0011	.0030	.0715	.0116
3	-18.980	-10.697	-.0019	.0040	-.1167	-.0190
4	21.473	10.776	.0021	.0039	.1320	.0215
5	-18.845	-8.069	-.0018	.0031	-.1159	-.0188
6	12.477	4.408	.0012	.0012	.0767	.0125

THIS OUTPUT IS OMITTED WHENEVER NOPRT = 1

STORY NO.	I. S. DEFL (IN)	VELOCITY (IN/SEC)	ACCELERATION (G)
1	2.1683+00	4.7143+01	9.2562-01
2	2.1595+00	3.3430+01	5.8147-01
3	2.0149+00	2.9602+01	6.8570-01
4	1.7787+00	2.2949+01	6.2369-01

```
 5           1.4615+00          1.5528+01          5.9266-01
 6           7.4590-01          6.9498+00          4.1131-01
DUCTILITY BY STORY
   1.16+00   1.15+00   1.08+00   9.50-01   7.81-01   3.98-01
EFFECTIVE DUCTILITY FOR BUILDING =    .68
CRITICAL DAMPING (PERCENT) =    5.33
```

MODE NO.	FREQUENCY (CPS)	PERIOD (SEC)	MASS RATIO	PSUDO-SPECTRAL VELOCITY	MAXIMUM BASE SHEAR	AMPLITUDE RATIO	PS.SPECT.VEL. MODIFIED FOR DUCTILITY (ACCEL)	(DISPL)
1	.6931	1.443	.708	29.314	1404.283	.719	29.314	29.314
2	3.0504	.328	.186	12.112	670.823	1.692	12.112	12.112
3	7.0557	.142	.066	3.770	171.789	2.850	3.770	3.770
4	9.9997	.100	.027	2.063	54.839	4.183	2.063	2.063
5	9.9997	.100	.010	2.063	19.851	7.520	2.063	2.063
6	9.9997	.100	.002	2.063	4.408	15.622	2.063	2.063

EFFECTIVE FORCE FOR MODE NO. 1

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	459.816	459.816	9.3688	1.8567	40.7980	.4598
2	368.692	828.507	7.5121	1.93X5	32.7129	.3687
3	273.549	1102.056	5.5736	1.9235	24.2712	.2735
4	179.143	1281.199	3.6501	1.7382	15.8948	.1791
5	93.831	1375.031	1.9118	1.3158	8.3254	.0938
6	29.252	1404.283	.5960	.5960	2.5954	.0293

THIS OUTPUT IS OMITTED
WHENEVER NOPRT = 1

EFFECTIVE FORCE FOR MODE NO. 2

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	-335.703	-335.703	-.3531	.3334	-6.7677	-.3357
2	-18.733	-354.436	-.0197	.2731	-.3777	-.0187
3	240.855	-113.581	.2533	.1202	4.8556	.2409
4	355.104	241.523	.3735	.0606	7.1589	.3551
5	297.466	538.989	.3129	.1742	5.9969	.2975
6	131.834	670.823	.1387	.1387	2.6578	.1318

EFFECTIVE FORCE FOR MODE NO. 3

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	105.828	105.828	.0208	.0383	.9224	.1058
2	-88.927	16.901	-.0175	.0082	-.7751	-.0889
3	-130.633	-113.733	-.0257	.0279	-1.1386	-.1306
4	11.372	-102.361	.0022	.0276	.0991	.0114
5	151.805	49.444	.0298	.0058	1.3231	.1518
6	122.345	171.789	.0241	.0241	1.0663	.1223

EFFECTIVE FORCE FOR MODE NO. 4

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	-37.144	-37.144	-.0036	.0104	-.2284	-.0371
2	69.391	32.247	.0068	.0063	.4267	.0694
3	5.219	37.466	.0005	.0078	.0321	.0052
4	-74.830	-37.364	-.0073	.0085	-.4602	-.0748
5	12.017	-25.347	.0012	.0067	.0739	.0120
6	80.186	54.839	.0078	.0078	.4831	.0802

EFFECTIVE FORCE FOR MODE NO. 5

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	14.449	14.449	.0014	.0054	.0889	.1444
2	-40.509	-26.061	-.0040	.0077	-.2491	-.0405
3	38.280	12.219	.0037	.0038	.2354	.0383
4	-.176	12.043	-.0000	.0036	-.0011	-.0002
5	-36.799	-24.756	-.0036	.0080	-.2263	-.0368
6	44.607	19.851	.0044	.0044	.2743	.0446

EFFECTIVE FORCE FOR MODE NO. 6

STORY	FORCE (KIPS)	SHEAR (KIPS)	DEFLECTION	STORY DRIFT	VELOCITY	ACCELERATION
1	-3.352	-3.352	-.0003	.0015	-.0206	-.0034
2	11.635	8.283	.0011	.0030	.0715	.0116
3	-18.980	-10.697	-.0019	.0040	-.1167	-.0190
4	21.473	10.776	.0021	.0039	.1321	.0215
5	-18.845	-8.069	-.0018	.0031	-.1159	-.0188
6	12.477	4.408	.0012	.0012	.0767	.0125

THIS OUTPUT IS OMITTED
WHENEVER NOPRT = 1

STORY NO.	I. S. DEFL (IN)	VELOCITY (IN/SEC)	ACCELERATION (G)
1	2.2456+00	4.8826+01	9.5629-01
2	2.2368+00	3.4613+01	5.9789-01
3	2.0872+00	3.0650+01	7.0752-01
4	1.8425+00	2.3746+01	6.4210-01
5	1.5135+00	1.6061+01	6.1076-01
6	7.7218-01	7.1637+00	4.2070-01

DUCTILITY BY STORY
1.20+00 1.19+00 1.11+00 9.84-01 8.09-01 4.12-01
EFFECTIVE DUCTILITY FOR BUILDING = .70
CRITICAL DAMPING (PERCENT) = 5.43
COMBINED FORCE FOR ALL MODES (METHOD 1)

STORY	FORCE (KIPS)	SHEAR (KIPS)
1	459.816	459.816
2	368.692	828.507
3	273.549	1102.056
4	179.143	1281.199
5	93.831	1375.031
6	29.252	1404.283

THIS OUTPUT IS OMITTED
WHENEVER NOPRT = 1

COMBINED FORCE FOR ALL MODES (METHOD 2)

STORY	FORCE(KIPS)	SHEAR(KIPS)
1	580.453	580.453
2	321.834	902.287
3	212.177	1114.465
4	193.947	1308.411
5	169.758	1478.169
6	88.657	1566.827

COMBINED FORCE FOR ALL MODES (METHOD 3)

STORY	FORCE(KIPS)	SHEAR(KIPS)
1	956.290	956.290
2	310.144	1266.434
3	123.318	1389.752
4	295.513	1685.265
5	336.372	2021.637
6	304.356	2325.993

THIS OUTPUT IS OMITTEI
WHENEVER NOPRT = 1

D A M A G E   A N A L Y S I S

DRIFT TO YIELD BY STORY (FRAME)
1.30-02 1.30-02 1.30-02 1.30-02 1.30-02 1.30-02
COEFFICIENT OF VARIATION BY STORY
2.50-01 2.50-01 2.50-01 2.50-01 2.50-01 2.50-01
DRIFT TO YIELD BY STORY (WALL)
1.30-02 1.30-02 1.30-02 1.30-02 1.30-02 1.30-02
COEFFICIENT OF VARIATION BY STORY
2.50-01 2.50-01 2.50-01 2.50-01 2.50-01 2.50-01
DRIFT TO YIELD BY STORY (DIAPHRAGM)
1.30-02 1.30-02 1.30-02 1.30-02 1.30-02 1.30-02
COEFFICIENT OF VARIATION BY STORY
2.50-01 2.50-01 2.50-01 2.50-01 2.50-01 2.50-01
HEIGHT OF WINDOWS BY STORY (INCHES)
6.00+01 6.00+01 6.00+01 6.00+01 6.00+01 6.00+01
WIDTH OF WINDOWS BY STORY (INCHES)
6.00+01 6.00+01 6.00+01 6.00+01 6.00+01 6.00+01
DUCTILITY TO FAILURE BY STORY (FRAME)

```
   1.80+01   1.80+01   1.80+01   1.80+01   1.80+01   1.80+01
COEFFICIENT OF VARIATION BY STORY
   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01
DUCTILITY TO FAILURE BY STORY (WALL)
   1.10+01   1.10+01   1.10+01   1.10+01   1.L0+01   1.10+01
COEFFICIENT OF VARIATION BY STORY
   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01
DUCTILITY TO FAILURE BY STORY (DIAPHRAGM)
   1.10+01   1.10+01   1.10+01   1.10+01   1.10+01   1.10+01
COEFFICIENT OF VARIATION BY STORY
   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01
QUALITY FACTOR OF CONSTRUCTION BY STORY
   3.00+00   3.00+00   3.00+00   3.00+00   3.00+00   3.00+00
AVERAGE CLEARANCE IN MULLIONS (INCHES)
   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01
COEFFICIENT OF VARIATION BY STORY
   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01   2.50-01
```

STRUCTURAL DAMAGE DUE TO EARTHQUAKE (PERCENT)

STORY NO.	FRAME DAMAGE	WALL DAMAGE	DIAPHRAGM DAMAGE
1	21.39	78.77	78.77
2	21.02	78.21	78.21
3	15.41	67.72	67.72
4	8.56	47.49	47.49
5	3.30	22.19	22.19
6	.19	.94	.94

NONSTRUCTURAL DAMAGE DUE TO EARTHQUAKE (PERCENT)

STORY NO.	MMI (A)	MMI (V)	MMI (A,V)	MULLION DRIFT	NONSTR DAMAGE	GLASS DAMAGE
1	10.2	9.8	10.2	1.56-02	10.40	39.85
2	9.5	9.4	9.5	1.55-02	4.20	39.28
3	9.8	9.2	9.8	1.45-02	5.81	30.11
4	9.6	8.9	9.6	1.28-02	4.82	17.64
5	9.5	8.5	9.5	1.05-02	4.37	6.98
6	9.0	7.5	9.0	5.36-03	2.13	.33

END OF JOB.

INPUT INSTRUCTIONS FOR THE CDC 3600 COMPUTER

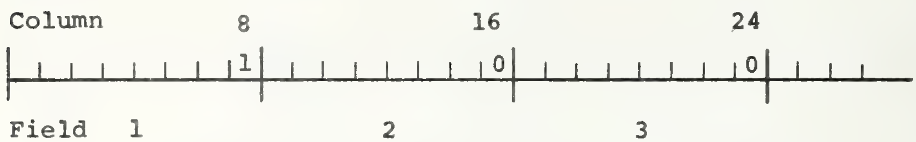
One of the stipulations regarding the development of this program was that it be operational on the CDC 3600 Computer. In order to satisfy this requirement, a modified version of the program was created. The modified version is identical to the basic program except for the input format and certain variations in the Fortran language. The latter are of no concern to the user. The purpose of the appendix is to describe the input format required by the modified version.

The primary difference between the input format in this version compared to the basic version of the program is that it is not free form as noted in Section 2.0. However, the organization of the input is identical. That is, there is a one-to-one correspondence between data cards except for overflow onto auxilary cards whenever all of the information for a given card (e.g. Card A) does not fit onto one card. This situation may arise whenever the elements of a vector are entered sequentially on a single card, such as "Card C" specified in Section 2.4.1,on which numerical values for the vector "HW" are punched.

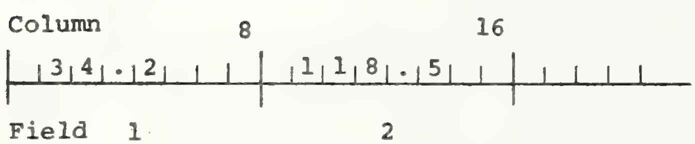
All of the input data for the CDC 3600 version must be entered in fields of eight (8) columns each. There may be as many as ten fields on any one card. Integer and floating point fields (Format I8 and E8.3) may occur on the same card. These are indicated by I of F as discussed in the main body of this manual. All interger values must be right justified in their particular fields. Floating point values may be punched anywhere in the field. Exponential format may be used for the latter. In this case, the exponent must be right justified, e.g. the number 29.0E3 must be written such that the "3" appears in the eighth column of the field.

The following examples illustrate the format requirements. These examples have been chosen from the Listing of Sample Data Input in Section 3.4.

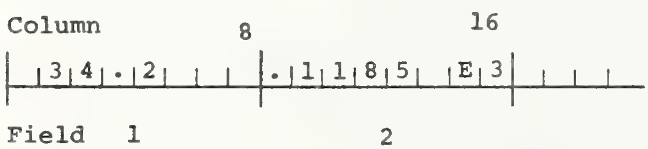
Example 1: Line 2 (Card B, Section 2.0)



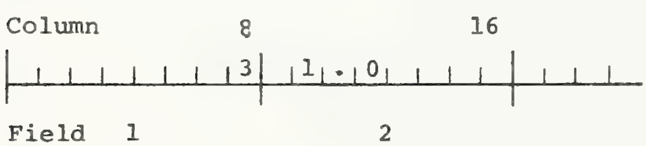
Example 2: Line 3 (Card C, Section 2.0)



Example 3: Line 3 (Card C, Section 2.0) Alternative format



Example 4: Line 10 (Card A, Section 2.1.1.2)



APPENDIX F

DETAILED ANALYTICAL METHOD - COMPUTER PROGRAM LISTING

This appendix contains a listing of the computer program used in the Detailed Analytical Method. The program is written in Fortran IV and is modularized to provide maximum flexibility for any future modification.

TABLE OF CONTENTS FOR COMPUTER PROGRAM

	Subroutine Call Statement Page (Row)	Subroutine Location Page (Row)
4. STATIC	F-42 (1)	
INVERT STIFFNESS MATRIX	F-42 (16)	
DECOMP	F-42 (18)	F-9 (1)
INVERS	F-42 (19)	F-12 (1)
COMPUTE WIND PRESSURE	F-42 (25)	
WIND	F-42 (28)	F-58 (1)
TORNADO	F-42 (34)	F-67 (1)
COMPUTE WIND DEFLECTION	F-42 (39)	
COMPUTE INTERSTORY DRIFT AND SHEAR	F-43 (59)	
5. LSROOF	F-68 (1)	
DETAILED SWISS ANALYSIS	F-70 (120)	
GENERAL ANSI ANALYSIS	F-68 (51)	
GENERAL SWISS ANALYSIS	F-68 (35)	
COMPUTE PONDING LOAD	F-71 (201)	
6. DAMAG	F-44 (1)	
EARTHQUAKE DAMAGE	F-45 (103)	
WIND AND TORNADO DAMAGE	F-46 (151)	
LONG-SPAN ROOF DAMAGE	F-47 (197)	

```
C       ************************************************************************
C       *                                                                      *
C       *                                                                      *
C       *     METHODOLOGY FOR HAZARD RISK ANALYSIS OF BUILDINGS                *
C       *                                                                      *
C       *     J H WIGGINS COMPANY                                              *
C       *     1650 S PACIFIC COAST HWY                                         *
C       *     REDONDO BEACH CALIFORNIA                                         *
C       *     JULY 31, 1973                                                    *
C       *                                                                      *
C       *                                                                      *
C       *     THIS PROGRAM WAS DEVELOPED BY THE J H WIGGINS COMPANY FOR        *
C       *     THE U S NATIONAL BUREAU OF STANDARDS UNDER CONTRACT NO.          *
C       *     3-35773. THE METHODOLOGY IS DESCRIBED IN A TECHNICAL REPORT      *
C       *     ACCOMPANIED BY A USERS MANUAL, BOTH OF WHICH WERE DELIVERED      *
C       *     WITH THE PROGRAM.                                                *
C       *                                                                      *
C       *     THE PROGRAM PROVIDES BASIC TOOLS FOR EVALUATING THE              *
C       *     DAMAGE TO BUILDINGS DUE TO EARTHQUAKE, WIND AND TORNADO.         *
C       *     SITE LOADS CORRESPONDING TO THESE NATURAL HAZARDS ARE            *
C       *     COMPUTED IN SUBROUTINE LOADS. BUILDING MODELS ARE GENERATED      *
C       *     IN SUBROUTINE STRUCT. RESPONSE IS COMPUTED IN SUBROUTINES        *
C       *     DYNAMC, STATIC AND LSROOF. DAMAGE PREDICTIONS ARE EVALUATED      *
C       *     IN SUBROUTINE DAMAG. A MORE DETAILED DESCRIPTION OF THE          *
C       *     PROGRAM IS CONTAINED IN THE USERS MANUAL, ALONG WITH INPUT       *
C       *     AND OUTPUT SPECIFICATIONS.                                       *
C       *                                                                      *
C       *                                                                      *
C       ************************************************************************
      REAL M,LC(30),S(70,70),EDEFL(30)
      REAL CEC(10),CIC(10),QMS(30),VMM(30)
      DIMENSION NHAZ(3),T(100),F(100),C(70),D(70,70),M(30),
     &E(30,30),FA(30),FV(30),DRFT(30),TITLE(18)
  600 FORMAT('0INCLUDE EARTHQUAKE HAZARD:',3X,I1,/,
     &'0INCLUDE WIND HAZARD:',9X,I1,/,
     &'0INCLUDE TORNADO HAZARD:',6X,I1)
  610 FORMAT('0EXERCISE RISK OPTION:',8X,I1,/,
     &'0BUILDING MODELING OPTION:',6X,I1,/,
     &'0EVALUATE DAMAGE TO LONG-SPAN ROOF:',5X,I1)
  620 FORMAT('0SITE LOCATION: LATITUDE',F9.2,2X,
     &'DEGREES, LONGITUDE',F8.2,2X,'DEGREES')
      READ(5,588) (TITLE(I),I=1,18)
  588 FORMAT(18A4)
      WRITE(6,688) (TITLE(I),I=1,18)
  688 FORMAT('1RUN IDENTIFICATION:',//,10X,18A4)
      READ(5,9000) (NHAZ(I),I=1,3)
 9000 FORMAT( )
      WRITE(6,600) (NHAZ(I),I=1,3)
      READ(5,9000) DLAT,DLONG
      WRITE(6,620) DLAT,DLONG
      READ(5,9000) LRISK,NMOD,LSROPT
      WRITE(6,610) LRISK,NMOD,LSROPT
      CALL LOADS(DLAT,DLONG,LRISK,NHAZ,T,F,VF,ISITE,ISHAPE,VT,BL,ITOR,FI
```

```
      &,EM)
       IF((NHAZ(1).EQ.0).AND.(NHAZ(2).EQ.0).AND.(ITOR.NE.1)) GO TO 99
       CALL STRUCT(NMOD,NS,LC,TWB,TLB,PHR,NOPRT,$99,M,S,E,C,D)
       T1=6.283/SQRT(C(1))
       IF(NHAZ(1).EQ.0) GO TO 10
       CALL DYNAMC(NS,LC,S,C,D,M,AR,VR,T,F,E,LD,NOPRT,NMOD)
       DO 30 I=1,NS
       FA(I)=E(I,6)
       FV(I)=E(I,5)
       EDEFL(I)=E(I,4)
    30 CONTINUE
    10 IF(NHAZ(2).EQ.0) GO TO 20
   100 CONTINUE
       CALL STATIC(NHAZ,NS,S,LC,TWB,PHR,T1,DRFT,VT,
      &D,VF,M,CEC,CIC,QMS,VMM,ISHAPE,ISITE,NMOD,ITOR,ITYPE)
    20 CONTINUE
       IF(LSROPT.EQ.0) GO TO 40
       IF(ITOR.EQ.-1) GO TO 36
       THB=0.
       DO 35 I=1,NS
    35 THB=THB+LC(I)
    36 P1=QMS(1)
       PI=VMM(1)
       CALL LSROOF(ITYPE,TLB,TWB,THB,P1,PI,IFLY,IW)
    40 CONTINUE
       CALL DAMAG(NHAZ,EM,AR,VR,NS,FA,FV,EDEFL,LC,T1,DRFT,
      &CEC,CIC,QMS,VMM,ITOR,LSROPT,IFLY,IW)
       IF((NHAZ(3).NE.0).AND.(ITOR.GT.0)) GO TO 98
       GO TO 99
    98 ITOR=-1
       GO TO 100
    99 CONTINUE
       WRITE(6,700)
   700 FORMAT('0END OF JOB.')
       STOP
       END


@PRT,S  FLMASS
```

```
HASSELMAN-T*TPFS.FLMASS
          SUBROUTINE FLMASS(NS,M)
C
C  THIS SUBROUTINE READS FLOOR WEIGHT DATA FOR THE BUILDING,
C  CONVERTS TO MASS, AND ADDS IT TO THE FRAMING MASS (IF ANY) FOR EACH
C  STORY.
C
          REAL M(30),FWT(30)
          READ(5,9000) (FWT(I),I=1,NS)
     9000 FORMAT ( )
          DO 10 I=1,NS
       10 M(I)=M(I)+FWT(I)/386.4
          RETURN
          END


@PRT,S  HOUSQR
```

HASSELMAN-T*TPFS.HOUSQR

```
          SUBROUTINE HOUSQR(N,G,E,X,A,B,PP)
              INTEGER N
              REAL E(70),G(70,70),X(70,70)
          INTEGER I,J,K,M,NQR,I1,K1,N1                                   736.
          REAL T,ALFA,BETA,GAMMA,ABSB,R,S,C,W,H,BK,AINEW,P,Q,F,
         1    A(100),B(100),PP(100)                                      738.
          DOUBLE PRECISION SUM,SIGMA,DPRS
          DO 29 I=1,100                                                  739.
          A(I)=0.0                                                       740.
          B(I)=0.0                                                       741.
       29 PP(I)=0.0                                                      742.
          DO 1  I = 1,N                                                  744.
              I1 = I+1                                                   745.
              X(I,I) = 1                                                 746.
              DO 1  J = I1,N                                             747.
                   X(I,J) = 0.0                                          748.
        1 X(J,I) = 0.0                                                   749.
          IF (N .GT. 1) GO TO 3                                          752.
          IF(N.NE.1) GOTO 2
                   E(1) = G(1,1)                                         754.
                   X(1,1) = 1.0                                          755.
        2     RETURN                                                     756.
        3 N1 = N-2                                                       757.
          IF (N .EQ. 2) GO TO 165                                        758.
          DO 16  K = 1,N1                                                759.
              K1 = K+1                                                   761.
              A(K) = G(K,K)                                              762.
              SIGMA = 0                                                  763.
              DO 4  I = K1,N                                             764.
        4     SIGMA=SIGMA+G(I,K)**2
              IF (SIGMA .EQ. 0.0) GO TO 16                               766.
              ABSB = DSQRT(SIGMA)
              ALFA = G(K1,K)                                             768.
              IF (ALFA .GE. 0) GO TO 5                                   769.
                   BETA = ABSB                                           770.
                   GO TO 6                                               771.
        5     BETA = -ABSB                                               772.
        6     B(K) = BETA                                                773.
              GAMMA = 1.0/(SIGMA - ALFA * BETA)                          774.
              G(K1,K) = ALFA - BETA                                      775.
              DO 9  I = K1,N                                             776.
                   SUM = 0                                               777.
                   IF (I .EQ. K) GO TO 75                                778.
                   DO 7  J = K1,I                                        779.
                   DPRS = G(J,K)
        7          SUM = SUM + G(I,J) *    DPRS
       75          I1 = I+1                                              781.
                   IF (I .EQ. N) GO TO 9                                 782.
                   DO 8  J = I1,N                                        783.
                   DPRS = G(J,K)
        8          SUM = SUM + G(J,I) * DPRS
        9     PP(I) = GAMMA * SUM                                        785.
              SUM = 0                                                    786.
```

```
      DO 10  I = K1,N                                                   787.
      DPRS = G(I,K)
10    SUM = SUM + DPRS * PP(I)
      T = 0.5 * GAMMA * SUM                                             789.
      DO 11  I = K1,N                                                   790.
11    PP(I) = PP(I) - T * G(I,K)                                        791.
      DO 12  I = K1,N                                                   792.
      DO 12  J = K1,N                                                   793.
12    G(I,J) = G(I,J) - G(I,K) * PP(J) - PP(I) * G(J,K)                 794.
      DO 14  I = 2,N                                                    795.
            SUM = 0                                                     796.
            DO 13  J = K1,N                                             797.
            DPRS = G(J,K)
13          SUM = SUM + X(I,J) * DPRS
14    PP(I) = GAMMA * SUM                                               799.
      DO 15  I = 2,N                                                    800.
      DO 15  J = K1,N                                                   801.
15    X(I,J) = X(I,J) - PP(I) * G(J,K)                                  802.
16 CONTINUE                                                             803.
165 N1 = N-1                                                            804.
   A(N1) = G(N1,N1)                                                     805.
   B(N1) = G(N,N1)                                                      806.
   A(N)  = G(N,N)                                                       807.
   NQR = 0                                                              810.
   R = ABS(A(N))                                                        814.
   DO 17  I = 1,N1                                                      815.
      S = ABS(A(I))                                                     816.
      IF (S .GT. R) R = S                                               817.
      S = ABS(B(I))                                                     818.
17 IF (S .GT. R) R = S                                                  819.
   IF (R .NE. 0.0) GO TO 19                                             820.
      DO 18  I = 1,N                                                    821.
18    E(I) = 0                                                          822.
      RETURN                                                            823.
19 E(N) = A(N)                                                          824.
   DO 20  I = 1,N1                                                      829.
20 E(I) = A(I)                                                          830.
   K = N                                                                831.
21 M = K                                                                832.
   IF (M .LE. 1) GO TO 28                                               833.
   T = ABS(E(K))                                                        835.
   B(M) = 0                                                             836.
22 K = K-1                                                              837.
      IF (K .LE. 0) GO TO 23                                            838.
      S = B(K)                                                          839.
      IF (T+S .EQ. T) GO TO 23                                          840.
      T = ABS(E(K))                                                     841.
      IF (T+S .EQ. T) GO TO 23                                          842.
      GO TO 22                                                          843.
23 IF (K .EQ. M-1) GO TO 21                                             844.
   K1 = K+1                                                             845.
   T = 1                                                                850.
   S = E(M) - E(M-1)                                                    851.
   R = B(M-1)                                                           852.
```

```
      IF (ABS(R)+ABS(S) .EQ. ABS(R)) GO TO 24                     853.
         W = 2.0 * R / S                                          854.
         T = W / (SQRT(W**2 + 1.0 ) + 1.0)                        855.
   24 NQR = NQR + M-K                                             856.
      H = E(K1) - (E(M) + T * R)                                  857.
      W = B(K1)                                                   858.
      BK = W                                                      859.
      T = SQRT(H ** 2 + W ** 2)                                   862.
      GO TO 26                                                    863.
   25    T = SQRT(H ** 2 + W ** 2)                                864.
         B(K) = T                                                 865.
   26    K = K+1                                                  866.
         C = H / T                                                867.
         S = W / T                                                868.
         P = E(K)                                                 869.
         F = C * P + S * BK                                       870.
         T = E(K+1)                                               871.
         Q = C * BK + S * T                                       872.
         BK = B(K+1)                                              873.
         W = S * BK                                               874.
         BK = C * BK                                              875.
         AINEW = F * C + Q * S                                    876.
         H = Q * C - F * S                                        877.
         E(K+1) = (P+T) - AINEW                                   878.
         E(K) = AINEW                                             879.
         DO 27  J = 1,N                                           880.
               P = X(J,K)
               Q = X(J,K+1)                                       883.
               X(J,K) = C * P + S * Q                             884.
   27    X(J,K+1)=C*Q - S*P
         IF (K .LT . M-1) GO TO 25                                886.
      B(M-1) = H                                                  887.
      K = K+1                                                     888.
      GO TO 21                                                    890.
   28 NQR = NQR/N                                                 891.
      I=1
  201     Q=10.0**8
          DO 200 J=1,N
                IF(E(J).GT.Q) GOTO 200
                Q=E(J)
                K=J
  200     CONTINUE
          IF(K.EQ.I) GOTO 203
          SUM=E(I)
          E(I)=E(K)
          E(K)=SUM
          DO 202 J=1,N
                A(J)=X(J,I)
                X(J,I)=X(J,K)
                X(J,K)=A(J)
  202     CONTINUE
  203     I=I+1
      IF(I.LT.N) GOTO 201
      RETURN
```

```
                END


@PRT,S  NORMAL



HASSELMAN-T*TPFS.NORMAL
                SUBROUTINE NORMAL(N,DN)
                REAL LARGE,DN(70,70)
                DO 7 I=1,N
                LARGE = 0.0
                DO 5 J=1,N
              5 IF(ABS(DN(J,I)).GT.ABS(LARGE)) LARGE=DN(J,I)
                DO 6 J=1,N
              6 DN(J,I)=DN(J,I)/LARGE
              7 CONTINUE
                RETURN
                END


@PRT,S  MATPRT



HASSELMAN-T*TPFS.MATPRT
                SUBROUTINE MATPRT (M,N,A)
                INTEGER RTCOL                                                675.
                DIMENSION A(70,70)                                           676.
            601 FORMAT ('0')                                                 677.
            602 FORMAT (' ',1P7E10.2)
                WRITE (6,601)                                                679.
                NPAGES = (N-1)/7 + 1
                DO 101 I=1,NPAGES                                            681.
                WRITE(6,601)
                LTCOL = 7*(I-1) + 1
                RTCOL = 7*I
                IF (RTCOL.GT.N) RTCOL=N                                      684.
                DO 101 J=1,M                                                 685.
            101 WRITE (6,602) (A(J,K),K=LTCOL,RTCOL)                         686.
                RETURN                                                       687.
                END                                                          688.


@PRT,S  EIGENS
```

```
HASSELMAN-T*TPFS.EIGENS
      SUBROUTINE EIGENS(S,MT,M,CV,DN,N,A,B,PP)
      REAL S(70,70),MT(30),M(30),CV(70),DN(70,70)              490.
      REAL A(100),B(100),PP(100)
      DO 2 I=1,N                                               499.
    2 MT(I)=1.0/SQRT(M(I))                                     500.
      DO 3 J=1,N                                               504.
      DO 3 K=1,N                                               505.
    3 S(J,K)=S(J,K)*MT(J)*MT(K)
      CALL HOUSQR (N,S,CV,DN,A,B,PP)
      DO 4 J=1,N                                               514.
      DO 4 K=1,N
    4 DN(J,K)=DN(J,K)*MT(J)                                    516.
      CALL NORMAL(N,DN)
      WRITE(6,608)                                             529.
  608 FORMAT('1CHARACTERISTIC VECTORS',/)                      530.
      CALL MATPRT(N,N,DN)
      RETURN                                                   551.
      END                                                      552.


@PRT,S  DECOMP


HASSELMAN-T*TPFS.DECOMP
      SUBROUTINE DECOMP(N,A,S)
      DIMENSION A(70,70)                                       447.
      DOUBLE PRECISION SUM,DA
      DO 3 I=1,N                                               449.
      DO 3 J=I,N                                               450.
      SUM=A(I,J)                                               451.
      KI=I-1
      IF(I.EQ.1)GOTO 1                                         453.
      DO 4 K=1,KI                                              454.
      DA = A(K,J)                                              455.
    4 SUM=SUM-A(K,I)*DA                                        456.
    1 IF(J.NE.I)GOTO 2                                         457.
      IF (SUM.LE.0.0) RETURN 3
      TEMP=1.0/DSQRT(SUM)                                      459.
      A(I,J)=TEMP                                              460.
      GOTO 3                                                   461.
    2 A(I,J)=SUM*TEMP                                          462.
    3 CONTINUE                                                 463.
      RETURN                                                   464.
      END                                                      465.


@PRT,S  INVERS
```

```
HASSELMAN-T*TPFS.INVERS
      SUBROUTINE INVERS(N,U)
      DIMENSION U(70,70)                                                  467.
      DOUBLE PRECISION SUM,DU
      I1=N-1                                                              469.
      DO 2 I=1,I1                                                         470.
      J1=I+1                                                              471.
      DO 2 J=J1,N                                                         472.
      SUM=0.0                                                             473.
      K1=J-1                                                              474.
      DO 1 K=I,K1
      DU = U(K,J)                                                         476.
    1 SUM=SUM-U(K,I)*DU                                                   477.
    2 U(J,I)=SUM*U(J,J)                                                   478.
      DO 4 I=1,N                                                          479.
      DO 4 J=I,N                                                          480.
      SUM=0.0                                                             481.
      DO 3 K=J,N                                                          482.
      DU = U(K,J)                                                         483.
    3 SUM=SUM+U(K,I)*DU                                                   484.
      U(I,J)=SUM
    4 U(J,I)=SUM                                                          486.
      RETURN                                                              487.
      END                                                                 488.

@PRT,S  CONDEN
```

```
HASSELMAN-T*TPFS.CONDEN
      SUBROUTINE CONDEN(NB,NS,SN,S,s)
      INTEGER SN,NB2,NB22,NBSN,NB2N,NB21                                329.
      REAL SAB(20,20),S(70,70)
      DOUBLE PRECISION TEMP,DS
      NB2=2*NB+2                                                        334.
C                                                                       335.
C     INVERT S(AA)                                                      336.
C                                                                       337.
      CALL DECOMP(NB2,S,$99)
      CALL INVERS (NB2,S)
C                                                                       340.
      IF(SN.EQ.NS) GOTO 20                                              341.
      DO 1 I=1,NB2                                                      342.
      DO 1 J=1,NB2
    1 SAB(I,J)=S(I,J+NB2)
C                                                                       344.
C     S(AA)-1 * S(AB) STORED IN S(AB), S(AA)-1 * S(AF) STORED IN S(FA)
C                                                                       346.
      DO 2 I=1,NB2                                                      347.
      DO 2 J=1,NB2                                                      348.
      TEMP=0.0
      DO 22 K=1,NB2
      DS=SAB(K,J)
   22 TEMP=TEMP+S(I,K)*DS
    2 S(I,J+NB2)=TEMP
   20 CONTINUE                                                          350.
      NB22=2*NB2+1                                                      351.
      NBSN=2*NB2+SN+1                                                   352.
      IF(SN.EQ.NS) NBSN=2*NB2+SN
      DO 4 I=1,NB2                                                      354.
      DO 4 J=NB22,NBSN                                                  355.
      TEMP=0.0                                                          356.
      DO 3 K=1,NB2                                                      357.
      DS = S(K,J)                                                       358.
    3 TEMP=TEMP+S(I,K)*DS                                               359.
    4 S(J,I)=TEMP                                                       360.
      IF(SN.EQ.NS) GOTO 21                                              361.
C                                                                       362.
C     S(BB)* = S(BB) - S(AB)T * S(AA)-1 * S(AB)                         363.
C                                                                       364.
      NB21=NB2+1                                                        365.
      NB2N=2*NB2                                                        366.
      DO 5 I=NB21,NB2N
      DO 5 J=NB21,NB2N
      TEMP=0.0
      DO 51 K=1,NB2
      DS=S(K,J)
   51 TEMP=TEMP+SAB(K,I-NB2)*DS
    5 S(I,J)=S(I,J)-TEMP
C                                                                       370.
C     S(BF)* = S(BF) - S(AB)T * S(AA)-1 * S(AF)                         371.
C                                                                       372.
      DO 6 I=NB21,NB2N                                                  373.
```

```
      DO 6 J=NB22,NBSN                                          374.
      TEMP=0.0
      DO 61 K=1,NB2
      DS=S(J,K)
   61 TEMP=TEMP+SAB(K,I-NB2)*DS
    6 S(I,J)=S(I,J)-TEMP
   21 CONTINUE                                                  376.
C                                                               377.
C     S(FF)* = S(FF) - S(AF)T * S(AA)-1 * S(AF)                 378.
C                                                               379.
      DO 8 I=NB22,NBSN                                          380.
      DO 8 J=NB22,NBSN                                          381.
      TEMP =0D.0                                                382.
      DO 7 K=1,NB2                                              383.
      DS = S(J,K)                                               384.
    7 TEMP = TEMP + S(K,I)*DS                                   385.
    8 S(I,J)=S(I,J)-TEMP                                        386.
      IF(SN.EQ.NS) GOTO 111
C                                                               388.
C     MOVE S(BB)* TO S(AA)  AND  S(BF)* TO S(AF)                389.
C                                                               390.
      DO 9 I=1,NB2                                              391.
      DO 9 J=1,NB2                                              392.
      S(I,J)=S(I+NB2,J+NB2)                                     393.
    9 S(I+NB2,J+NB2)=0.0                                        394.
      DO 10 I=1,NB2                                             395.
      DO 10 J=NB22,NBSN                                         396.
      S(I,J)=S(I+NB2,J)                                         397.
   10 S(I+NB2,J)=0.0                                            398.
  111 CONTINUE
      DO 12 I=1,NB2                                             410.
      DO 12 J=NB21,NB2N                                         411.
   12 S(I,J)=0.0
      GOTO 11                                                   413.
   99 RETURN 5
   11 CONTINUE                                                  415.
      RETURN                                                    416.
      END                                                       417.
```

@PRT.S READ2

HASSELMAN-T*TPF$.READ2

```
      SUBROUTINE READ2(NB,NS,LC,NDLC ,NOPT)
      REAL LB(10),LC(30),AB(99),AC(99),IB(99),IC(99),WB(99),WC(99)        10.
      REAL  AL(10),BL(10),FB(99),FC(99),
     $       ALB(200),BLB(200),SCJB(200),
     $     SCKB(200),ALC(220),BLC(220),SCJC(220),SCKC(220)
      INTEGER SUM
      INTEGER BTP(200),CTP(220),BBTP1(200),BBTP2(200)
      COMMON /DATA/ BTP,CTP,LB,AB,AC,IB,IC,E,WB,WC,ALB,BLB,SCJB,
     $ SCKB,ALC,BLC,SCJC,SCKC,BBTP1,BBTP2,ABR(20)
     $ ,AL,BL,FB,FC,G,EB,GB
      IF(NOPT.EQ.3) GOTO 105
      READ(5,9000) NB,NBT,NCT,E,G,EB,GB,WTB,WTC,NDLC
 9000 FORMAT ( )
      IF(EB .EQ. 0.0) EB=E
      IF(GB .EQ. 0.0) GB=G
      WRITE(6,501) NB,EB,GB,WTB,E,G,WTC
  501 FORMAT('0 NUMBER OF BAYS  =',I5,/,
     $ '0 BEAMS&     E=',F9.1,'  G=',F9.1,'  W(LBS/CU.FT)=',F9.2,/,
     $ '0 COLUMNS&  E=',F9.1,'  G=',F9.1,'  W(LBS/CU.FT)=',F9.2,/)
      IF(NBT.EQ.0) GOTO 73
      WRITE(6,601)                                                        45.
  601 FORMAT('0BEAM TYPE          AB         IB         FB',/)
      DO 2 I=1,NBT
      READ(5,9000) J,B1,D1,ISECT
      IF(ISECT.GT.2) READ(5,9000) T1,T2
      GOTO(2001,2002,2003,2004),ISECT
 2001 AB(J)=B1*D1
      IB(J)=B1*D1**3/12.0
      FB(J)=1.20
      GOTO 2005
 2002 B1=B1/2.0
      AB(J)=3.1416*B1*B1
      IB(J)=3.1416*B1**4/4.0
      FB(J)=1.111111
      GOTO 2005
 2003 AB(J)=T1*(D1-2.*T2)+T2*2.*B1
      IB(J)=B1*D1**3/12.0-(B1-T1)*(D1-2.*T2)**3/12.0
      FB(J)=AB(J)/D1/T1
      GOTO 2005
 2004 AB(J)=T2*T1+B1*(D1-T1)
      Y=(B1*(D1-T1)**2/2.0+T2*T1*(D1-T1/2.0))/AB(J)
      IB(J)=B1*D1**3/12.0+(T2-B1)*T1**3/12.0+
     $      B1*D1*(D1/2.0-Y)**2+(T2-B1)*T1*(D1-T1/2.0-Y)**2
      FB(J)=AB(J)/(B1*D1)
 2005 WB(J)=AB(J)*WTB/1728./1000.
      WRITE(6,602)J,AB(J),IB(J),FB(J)
  602 FORMAT (I10,F12.1,F11.1,F11.2,F11.1,F10.3)
    2 CONTINUE
   73 IF(NCT.EQ.0) GOTO 74
      WRITE(6,603)
  603 FORMAT('0COLUMN TYPE        AC         IC         FC',/)
      DO 3 I=1,NCT
      READ(5,9000) J,B1,D1,ISECT
```

```
      IF(ISECT.GT.2)READ(5,9000) T1,T2
      GOTO (3001,3002,3003,3004),ISECT
 3001 AC(J)=B1*D1
      IC(J)=B1*D1**3/12.0
      FC(J)=1.20
      GOTO 3005
 3002 B1=B1/2.0
      AC(J)=3.1416*B1*B1
      IC(J)=3.1416*B1**4/4.0
      FC(J)=1.111111
      GOTO 3005
 3003 AC(J)=T1*(D1-2.*T2)+T2*2.*B1
      IC(J)=B1*D1**3/12.0-(B1-T1)*(D1-2.*T2)**3/12.0
      FC(J)=AC(J)/D1/T1
      GOTO 3005
 3004 AC(J)=T2*T1+B1*(D1-T1)
      Y=(B1*(D1-T1)**2/2.0+T2*T1*(D1-T1/2.0))/AC(J)
      IC(J)=B1*D1**3/12.0+(T2-B1)*T1**3/12.0+
     $      B1*D1*(D1/2.0-Y)**2+(T2-B1)*T1*(D1-T1/2.0-Y)**2
      FC(J)=AC(J)/(B1*D1)
 3005 WC(J)=AC(J)*WTC/1728./1000.
      WRITE(6,612)J,AC(J),IC(J),FC(J)
  612 FORMAT(I10,F12.1,F11.1,F11.2,2F11.1,F10.3)
    3 CONTINUE                                                          60.
   74 CONTINUE
      WRITE(6,604)                                                      65.
  604 FORMAT('0BAY WIDTHS ------',/)                                    66.
      SUM=0                                                             67.
    4 READ(5,9000)NUM,BW,BL1,AL2
      WRITE(6,605) NUM,BW
  605 FORMAT(I6,' BAYS AT',F10.3,' INCHES')                             71.
      J1=SUM+1                                                          72.
      J2=SUM+NUM                                                        73.
      DO 102 J=J1,J2                                                    74.
      BL(J)=BL1
      AL(J+1)=AL2
  102 LB(J)=BW                                                          75.
      SUM=SUM+NUM                                                       76.
      IF(SUM.LT.NB) GOTO 4                                              77.
  105 CONTINUE
      WRITE(6,606)                                                      78.
  606 FORMAT('0STORY HEIGHTS -------',/)                                79.
      SUM=0                                                             80.
    5 READ(5,9000) NUM,SH
      WRITE(6,607)NUM,SH                                                82.
  607 FORMAT(I6,' STORIES AT',F10.3,' INCHES')                          83.
      J1=SUM+1                                                          84.
      J2=SUM+NUM                                                        85.
      DO 101 J=J1,J2                                                    86.
  101 LC(J)=SH                                                          87.
      SUM=SUM+NUM                                                       88.
      IF(SUM.LT.NS) GOTO 5                                              89.
      RETURN
      END                                                               250.
```

@PRT,S SFRAME

```
HASSELMAN-T*TPFS.SFRAME
      SUBROUTINE SFRAME(NB,NS,LC,SN,S,NOPRT,NRFJ,NBB)
      REAL S(70,70),L
      REAL LB(10),LC(30),AB(99),AC(99),IB(99),IC(99),WB(99),WC(99)          253.
      INTEGER BTP(200),CTP(220),BBTP1(200),BBTP2(200)
      REAL ALB(200),BLB(200),SCJB(200),SCKB(200),ALC(220),BLC(220),
     $ SCJC(220),SCKC(220)
     $ ,AL(10),BL(10),FB(99),FC(99)
      COMMON /DATA/ BTP,CTP,LB,AB,AC,IB,IC,E,WB,WC,ALB,BLB,SCJB,
     $ SCKB,ALC,BLC,SCJC,SCKC,BBTP1,BBTP2,ABR(20)
     $ ,AL,BL,FB,FC,G,EB,GB
      INTEGER B1,B2,BN,C1,C2,CN,BT,CT,SUM,SN,F1,F2                          256.
      SUM=0                                                                 257.
      IFR=0
      A=0.0
      B=0.0
      SCJ=0.0
      SCK=0.0
      NC=NB+1
      R9=1.0
      IF(SN.EQ.NS) R9=0.0
      IF(NOPRT.NE.1)WRITE(6,600)SN
      IBTP=(SN-1)*NB
       ICTP=(SN-1)*(NB+1)
  600 FORMAT('0STORY NO.',I5,' -------STRUCTURE DATA',/,'0BEAM     AREA     260.
     *       IZ      W(DL) ',5X,'A',7X,'B',3X,'SCJ',5X,'SCK',/)
    1 IF(NRFJ.EQ.1) GOTO 80
      READ(5,9000)NUM,BT
 9000 FORMAT ( )
      GOTO 81
   80 READ(5,9000)NUM,BT,IFR,A,B,SCJ,SCK
   81 CONTINUE
      B1=SUM+1                                                              264.
      B2=SUM+NUM                                                            265.
      DO 2 BN=B1,B2                                                         266.
      L=LB(BN)-A-B
      SCM2=4.0*E*IB(BT)/L
      SCM3=1.5*SCM2/L
      SCM4=2.0*SCM3/L
      ALB(IBTP+BN)=A
      BLB(IBTP+BN)=B
      SCJB(IBTP+BN)=SCJ
      SCKB(IBTP+BN)=SCK
      BTP(IBTP+BN)=BT
      IF(IFR.EQ.1)GOTO 59
      EJ=0.0
      EK=0.0
      GOTO 60
   59 EJ=SCM2/4.0/SCJ
      EK=SCM2/4.0/SCK
   60 ES=12.0*EJ*EK+4.0*(EJ+EK)+1.0
      E1=EJ+EK+1.0
      E2J=2.0*EJ+1.0
      E2K=2.0*EK+1.0
```

```
      E3J=3.0*EJ+1.0
      E3K=3.0*EK+1.0
      IF(NOPRT.NE.1)WRITE(6,601)BN,AB(BT),IB(BT),WB(BT),A,B,SCJ,SCK
  601 FORMAT(I5,F9.1,F12.1,F9.5,2F8.2,1P2E9.2)
      J1=(BN-1)*2+1                                                     273.
      J2=J1+1                                                           274.
      K1=J2+1                                                           275.
      K2=K1+1                                                           276.
      S(J1,J1)=S(J1,J1)+SCM4*E1/ES
      S(J1,J2)=S(J1,J2)+SCM3*(E2K+2.0*(A/L)*E1)/ES
      S(J1,K1)=S(J1,K1)-SCM4*E1/ES
      S(J1,K2)=S(J1,K2)+SCM3*(E2J+2.0*B*E1/L)/ES
      S(J2,J2)=S(J2,J2)+SCM2*(E3K+3.0*(A/L)*(E2K+(A/L)*E1))/ES
      S(J2,K1)=S(J2,K1)-SCM3*(E2K+2.0*A*E1/L)/ES
      S(J2,K2)=S(J2,K2)+SCM2/2.0*(1.0+3.0*(A/L)*E2J+3.0*B/L*
     $E2K+6.0*A*B*E1/L/L)/ES
      S(K1,K1)=S(K1,K1)+SCM4*E1/ES
      S(K1,K2)=S(K1,K2)-SCM3*(E2J+2.0*B*E1/L)/ES
      S(K2,K2)=S(K2,K2)+SCM2*(E3J+3.0*B*(E2J+B*E1/L)/L)/ES
    2 CONTINUE
      SUM=SUM+NUM                                                       287.
      IF(SUM.LT.NB)GOTO 1                                               288.
      SUM=0                                                             289.
      F1=NC*4+SN
      F2=F1+1
      IF(SN.EQ.NS) F2=F1
      IF(NOPRT.NE.1)WRITE(6,602)
  602 FORMAT('0COLUMN                   ',/)
    3 IF(NRFJ.EQ.1) GOTO 82
      READ(5,9000)NUM,CT
      GOTO 83
   82 READ(5,9000)NUM,CT,IFR,A,B,SCJ,SCK
   83 CONTINUE
      C1=SUM+1                                                          293.
      C2=SUM+NUM                                                        294.
      DO 4 CN=C1,C2                                                     295.
      L=LC(SN)-A-B
      SCM2=4.0*E*IC(CT)/L
      SCM3=1.5*SCM2/L
      SCM4=2.0*SCM3/L
      ALC(ICTP+CN)=A
      BLC(ICTP+CN)=B
      SCJC(ICTP+CN)=SCJ
      SCKC(ICTP+CN)=SCK
      CTP(ICTP+CN)=CT
      IF(IFR.EQ.1)GOTO 69
      EJ=0.0
      EK=0.0
      GOTO 70
   69 EJ=SCM2/4.0/SCJ
      EK=SCM2/4.0/SCK
   70 ES=12.0*EJ*EK+4.0*(EJ+EK)+1.0
      E1=EJ+EK+1.0
      E2J=2.0*EJ+1.0
```

```
      E2K=2.0*EK+1.0
      E3J=3.0*EJ+1.0
      E3K=3.0*EK+1.0
      IF(NOPRT.NE.1)WRITE(6,601)CN,AC(CT),IC(CT),WC(CT),A,B,SCJ,SCK
      J1=CN*2-1                                                         298.
      J2=J1+1                                                           299.
      K1=J1+NC*2                                                        300.
      K2=K1+1                                                           301.
      SCM1=E*AC(CT)/LC(SN)                                              304.
      S(F1,F1)=S(F1,F1)+SCM4*E1/ES
      S(J2,F1)=S(J2,F1)+SCM3*(E2K+2.0*A*E1/L)/ES
      S(J1,J1)=S(J1,J1)+SCM1                                            310.
      S(J2,J2)=S(J2,J2)+SCM2*(E3K+3.0*(A/L)*(E2K+(A/L)*E1))/ES
      IF(SN.EQ.NS) GOTO 4                                               312.
      S(K2,F1)=S(K2,F1)+SCM3*(E2J+2.0*B*E1/L)/ES
      S(J1,K1)=-SCM1                                                    314.
      S(J2,K2)=SCM2/2.0*(1.0+3.0*(A/L)*E2J+3.0*B/L*
     $E2K+6.0*A*B*E1/L/L)/ES
      S(K1,K1)=SCM1                                                     316.
      S(K2,K2)=SCM2*(E3J+3.0*B*(E2J+B*E1/L)/L)/ES
      S(F1,F2)=S(F1,F2)-SCM4*E1/ES
      S(F2,F1)=S(F1,F2)
      S(J2,F2)=-SCM3*(E2K+2.0*A*E1/L)/ES
      S(K2,F2)=-SCM3*(E2J+2.0*B*E1/L)/ES
      S(F2,F2)=S(F2,F2)+SCM4*E1/ES
    4 CONTINUE                                                          323.
      SUM=SUM+NUM
      IF(SUM.LT.NB+1) GOTO 3
      IF(NBB.EQ.0) GOTO 91
      IF(NOPRT .NE. 1) WRITE(6,603)
  603 FORMAT('0BRACE    AREA      AREA',/)
      DO 9 I=1,NBB
      READ(5,9000) BN,BT,CT
      BBTP1(IBTP+BN)=BT
      BBTP2(IBTP+BN)=CT
      L=SQRT(LB(BN)**2+LC(SN)**2)
      J1=BN*2-1
      J2=(BN+1)*2-1
       K1=J1+NC*2
      K2=J2+NC*2
      CX=LB(BN)/L
      CY=LC(SN)/L
      SCM1=E*ABR(BT)/L
      SCM2=E*ABR(CT)/L
      S(F2,F2)=S(F2,F2) + CX*CX*R9*(SCM1+SCM2)
      S(F2,F1)=S(F2,F1) - CX*CX*R9*(SCM1+SCM2)
      S(K1,F2)=S(K1,F2) + CX*CY*R9*SCM1
      S(K1,K1)=S(K1,K1) + CY*CY*R9*SCM1
      S(K1,F1)=S(K1,F1) - CX*CY*R9*SCM1
      S(F1,F2)=S(F1,F2) - CX*CX*R9*(SCM1+SCM2)
      S(F1,F1)=S(F1,F1) + CX*CX*(SCM1+SCM2)
      S(J2,F2)=S(J2,F2) - CX*CY*R9*SCM1
      S(J2,K1)=S(J2,K1) - CY*CY*R9*SCM1
      S(J2,F1)=S(J2,F1) + CX*CY*SCM1
```

```
      S(J2,J2)=S(J2,J2) + CY*CY*SCM1
      CY=-CY
      S(J1,F1)=S(J1,F1) + CX*CY*SCM2
      S(J1,J1)=S(J1,J1) + CY*CY*SCM2
      S(J1,F2)=S(J1,F2) - CX*CY*R9*SCM2
      S(J1,K2)=S(J1,K2) - CY*CY*R9*SCM2
      S(K2,F1)=S(K2,F1) - CX*CY*R9*SCM2
      S(K2,F2)=S(K2,F2) + CX*CY*R9*SCM2
      S(K2,K2)=S(K2,K2) + CY*CY*R9*SCM2
      IF(NOPRT.NE.1) WRITE(6,601) BN,ABR(BT),ABR(CT)
    9 CONTINUE
   91 CONTINUE
      RETURN
      END
```

327.

```
@PRT,S  GFRAME
```

HASSELMAN-T*TPFS.GFRAME

```
      SUBROUTINE GFRAME(NB,NS,LC,SN,S,NOPRT)
      REAL S(70,70),L,AL(10),BL(10),FB(99),FC(99)
      REAL LB(10),LC(30),AB(99),AC(99),IB(99),IC(99),WB(99),WC(99)        253.
     $ ,ALB(200),BLB(200),SCJB(200),SCKB(200),
     $ ALC(220),BLC(220),SCJC(220),SCKC(220)
      INTEGER BTP(200),CTP(220),BBTP1(200),BBTP2(200)
      COMMON /DATA/ BTP,CTP,LB,AB,AC,IB,IC,E,WB,WC,ALB,BLB,SCJB,
     $ SCKB,ALC,BLC,SCJC,SCKC,BBTP1,BBTP2,ABR(20)
     $ ,AL,BL,FB,FC,G,EB,GB
      INTEGER B1,B2,BN,C1,C2,CN,BT,CT,SUM,SN,F1,F2                        256.
      SUM=0                                                               257.
      NC=NB+1                                                             258.
      IF(NOPRT.NE.1)WRITE(6,600)SN
      IBTP=(SN-1)*NB
       ICTP=(SN-1)*(NB+1)
  600 FORMAT('0STORY NO.',I5,' -------STRUCTURE DATA',/,'0BEAM     AREA   260.
     *      IZ      W(DL) ',5X,'BL1',7X,'AL1',/)
    1 READ(5,9000) NUM,BT
 9000 FORMAT ( )
      B1=SUM+1                                                            264.
      B2=SUM+NUM                                                          265.
      DO 2 BN=B1,B2                                                       266.
      L=LB(BN)-BL(BN)-AL(BN+1)
      BTP(IBTP+BN)=BT
      IF(NOPRT.NE.1)WRITE(6,601)BN,AB(BT),IB(BT),WB(BT),BL(BN),AL(BN+1)
  601 FORMAT(I5,2F10.1,F10.5,2F10.2)
      G1=6.0*FB(BT)*EB*IB(BT)/GB/AB(BT)/L/L
      SCM2=4.0*EB*IB(BT)/L/(1.0+2.0*G1)
      SCM3=1.5*SCM2/L
      SCM4=2.0*SCM3/L
      J1=(BN-1)*2+1                                                       273.
      J2=J1+1                                                             274.
      K1=J2+1                                                             275.
      K2=K1+1                                                             276.
      B=AL(BN+1)
      A=BL(BN)
      S(J1,J1)=S(J1,J1)+SCM4                                              277.
      S(J1,J2)=S(J1,J2)+SCM3*(1.0+2.0*A/L)
      S(J1,K1)=S(J1,K1)-SCM4                                              279.
      S(J1,K2)=S(J1,K2)+SCM3*(1.0+2.0*B/L)
      S(J2,J2)=S(J2,J2)+SCM2*(1.0+3.0*(A/L)*(1.0+A/L))*(1.0+G1/2.0)
      S(J2,K1)=S(J2,K1)-SCM3*(1.0+2.0*A/L)
      S(J2,K2)=S(J2,K2)+SCM2/2.0*(1.0+3.0*(A/L)+3.0*(B/L)+
     $              6.0*A*B/L/L)*(1.0-G1)
      S(K1,K1)=S(K1,K1)+SCM4                                              284.
      S(K1,K2)=S(K1,K2)-SCM3*(1.0+2.0*B/L)
      S(K2,K2)=S(K2,K2)+SCM2*(1.0+3.0*(B/L)*(1.0+B/L))*(1.0+G1/2.0)
    2 CONTINUE
      SUM=SUM+NUM                                                         287.
      IF(SUM.LT.NB)GOTO 1                                                 288.
      SUM=0                                                               289.
      IF(NOPRT.NE.1)WRITE(6,602)
  602 FORMAT('0COLUMN  AREA        IZ      W(DL)',/)                      291.
```

```
    3 READ(5,9000) NUM,CT
      C1=SUM+1
      C2=SUM+NUM                                                    294.
      DO 4 CN=C1,C2                                                 295.
      CTP(ICTP+CN)=CT
      IF(NOPRT.NE.1)WRITE(6,631)CN,AC(CT),IC(CT),WC(CT)
      J1=CN*2-1                                                     298.
      J2=J1+1                                                       299.
      K1=J1+NC*2                                                    300.
      K2=K1+1                                                       301.
      F1=NC*4+SN                                                    302.
      F2=F1+1                                                       303.
      SCM1=E*AC(CT)/LC(SN)                                          304.
      G1=6.0*FC(CT)*E*IC(CT)/G/AC(CT)/LC(SN)/LC(SN)
      SCM2=4.0*E*IC(CT)/LC(SN)/(1.0+2.0*G1)
      SCM3=1.5*SCM2/LC(SN)                                          306.
      SCM4=2.0*SCM3/LC(SN)                                          307.
      S(F1,F1)=S(F1,F1)+SCM4                                        308.
      S(J2,F1)=S(J2,F1)+SCM3                                        309.
      S(J1,J1)=S(J1,J1)+SCM1                                        310.
      S(J2,J2)=S(J2,J2)+SCM2*(1.0+G1/2.0)
      IF(SN.EQ.NS) GOTO 4                                           312.
      S(K2,F1)=S(K2,F1)+SCM3                                        313.
      S(J1,K1)=-SCM1                                                314.
      S(J2,K2)=SCM2/2.0*(1.0-G1)
      S(K1,K1)=SCM1                                                 316.
      S(K2,K2)=SCM2*(1.0+G1/2.0)
      S(F1,F2)=S(F1,F2)-SCM4                                        318.
      S(F2,F1)=S(F2,F1)-SCM4                                        319.
      S(J2,F2)=-SCM3                                                320.
      S(K2,F2)=-SCM3                                                321.
      S(F2,F2)=S(F2,F2)+SCM4                                        322.
    4 CONTINUE                                                      323.
      SUM=SUM+NUM                                                   324.
      IF(SUM.LT.NB+1) GOTO 3                                        325.
      RETURN                                                        326.
      END                                                           327.
```

@PRT,S FRMASS

```
HASSELMAN-T*TPFS.FRMASS
              SUBROUTINE FRMASS(M,SN,LC,NB,NOPRT)
              REAL LB(10),LC(30),AB(99),AC(99),IB(99),IC(99),WB(99),WC(99)
              INTEGER BTP(200),CTP(220),BBTP1(200),BBTP2(200)
              REAL ALB(200),BLB(200),SCJB(200),SCKB(200),ALC(220),BLC(220),
             & SCJC(220),SCKC(220)
             & ,AL(10),BL(10),FB(99),FC(99)
              REAL M(30)
              COMMON /DATA/ BTP,CTP,LB,AB,AC,IB,IC,E,WB,WC,ALB,BLB,SCJB,
             & SCKB,ALC,BLC,SCJC,SCKC,SB(99),SC(99),BBTP1,BBTP2,ABR(20)
             & ,AL,BL,FB,FC,G,EB,GB
              INTEGER SN,BN,CN,BT,CT
              NC=NB+1
              G=386.4
        9000  FORMAT ( )
         601  FORMAT('0TOTAL WEIGHT OF STORY FRAMING =',F15.3,' KIPS')
              IBTP=(SN-1)*NB
              DO 1 BN=1,NB
              BT=BTP(IBTP+BN)
            1 M(SN)=M(SN)+WB(BT)*LB(BN)/G
              ICTP=(SN-1)*NC
              DO 2 CN=1,NC
              CT=CTP(ICTP+CN)
              M(SN)=M(SN)+WC(CT)*LC(SN)/2.0/G
              IF(SN.EQ.1) GOTO 2
              CT=CTP(ICTP+CN)
              M(SN)=M(SN)+WC(CT)*LC(SN-1)/2.0/G
            2 CONTINUE
              WTL = M(SN)*G
              IF(NOPRT.NE.1)WRITE(6,601) WTL
              RETURN
              END

@PRT,S  SDATA
```

HASSELMAN-T.TPFS.SDATA

```
      SUBROUTINE SDATA
      REAL LB(10),AB(99),AC(99),IB(99),IC(99),WB(99),WC(99)
     $         ,AL(10),BL(10),FB(99),FC(99)
      INTEGER BTP(200),CTP(220),BBTP1(200),BBTP2(200)
      REAL ALB(200),BLB(200),SCJB(200),SCKB(200),ALC(220),BLC(220),
     $ SCJC(220),SCKC(220)
      COMMON /DATA/ BTP,CTP,LB,AB,AC,IB,IC,E,WB,WC,ALB,BLB,SCJB,
     $ SCKB,ALC,BLC,SCJC,SCKC ,BBTP1,BBTP2,ABR(20)
     $ ,AL,BL,FB,FC,G,EB,GB
      DATA AB
     1/ 7.67,9.13,10.6,11.8,13.3,14.7,17.1,18.8,20.9,23.0,25.9,28.2,
     2  10.3,11.8,13.2,14.7,16.2,17.7,18.9,20.6,22.7,25.0,28.2,30.9,
     3  33.5,13.0,14.4,16.2,18.3,20.0,21.5,24.2,28.3,33.0,37.4,41.8,
     4  16.2,18.0,20.0,22.4,24.7,27.7,29.5,32.5,35.4,38.3,42.7,47.1,
     5  24.8,27.7,30.0,33.6,42.7,47.1,52.2,29.1,31.8,34.2,36.5,38.9,
     6  50.7,56.0,61.9,34.8,38.3,41.6,44.8,58.9,64.8,70.6,39.8,44.2,
     7  47.1,50.0,53.6,57.2,67.7,72.1,76.5,82.4,88.3,100.,0.00/
      DATA IB
     1/ 300.,374.,447.,517.,584.,657.,748.,836.,941.,1050.,1220.,
     2  1360.,513.,612.,706.,802.,891.,986.,1050.,1160.,1290.,1440.,
     3  1680.,1850.,2040.,843.,971.,1140.,1330.,1480.,1600.,1760.,
     4  2100.,2620.,3020.,3410.,1340.,1540.,1820.,2100.,2370.,2690.,
     5  3000.,3330.,3650.,4020.,4570.,5120.,2830.,3270.,3610.,4090.,
     6  5430.,6030.,6740.,4000.,4470.,4930.,5360.,5760.,7910.,8850.,
     7  9890.,5900.,6710.,7460.,8160.,11100.,12300.,13600.,7820.,
     8  9030.,9760.,10500.,11300.,12100.,15000.,16100.,17300.,
     9  18900.,20300.,1.,1./
      DATA WB
     1/ 26.,31.,36.,40.,45.,50.,58.,64.,71.,78.,88.,96.,35.,40.,45.,
     2  50.,55.,60.,64.,70.,77.,85.,96.,105.,114.,44.,49.,55.,62.,68.,
     3  73.,82.,96.,112.,127.,142.,55.,61.,68.,76.,84.,94.,100.,110.,
     4  120.,130.,145.,160.,84.,94.,102.,114.,145.,160.,177.,99.,108.,
     5  116.,124.,132.,172.,190.,210.,118.,130.,141.,152.,200.,220.,
     6  240.,135.,153.,160.,170.,182.,194.,230.,245.,260.,280.,300.,
     7  0.,0./
      DATA AC
     1/ 17.9,20.0,21.8,22.9,24.7,25.6,27.9,30.3,32.7,35.0,37.3,
     2  40.0,41.8,44.1,46.5,49.1,51.7,54.1,56.7,59.4,62.1,64.4,
     3  67.1,69.7,72.3,77.6,84.4,92.3,101.,109.,117.,125.,134.,
     4  147.,162.,178.,196.,215.,1.00/
      DATA IC
     1/ 641.0,724.0,797.0,851.0,928.0,967.0,1060.,1170.,1270.,1370.,
     2  1480.,1590.,1670.,1790.,1900.,2020.,2150.,2270.,2400.,2540.,
     3  2670.,2800.,2940.,3080.,3230.,3530.,3910.,4400.,4910.,5450.,
     4  6010.,6610.,7220.,8250.,9450.,10900.,12500.,14400.,1.00,11.0.0,
     5  107.0,121.0,133.0,207.0,225.0,350.0,384.0,420.0,455.0,492.0,
     6  528.0,568.0,660.0,703.0,745.0,790.0,838.0,883.0,930.0,980.0,
     7  1030.,1070.,1120.,1170.,1230.,1330.,1470.,1630.,1810.,1990.,
     8  2170.,2360.,2560.,2880.,3260.,3680.,4170.,4720.,1.000/
      DATA WC
     1/ 61.0,68.0,74.0,78.0,84.0,87.0,95.0,103.,111.,119.,127.,
     2  136.,142.,150.,158.,167.,176.,184.,193.,202.,211.,219.,
     3  228.,237.,246.,264.,287.,314.,342.,370.,398.,426.,455.,
```

```
     4  500.,550.,605.,665.,730.,0.00/
      DO 10 I=1,38
      I2=50+I
      WC(I)=WC(I)/1000.0/12.0
      AC(I2)=AC(I)
      WC(I2)=WC(I)
   10 CONTINUE
      DO 20 I=1,81
   20 WB(I)=WB(I)/1000.0/12.0
      DO 21 I=1,99
      FB(I)=0.0
   21 FC(I)=0.0
      RETURN
      END
```

@PRT,S SPECTR

HASSELMAN-T*TPFS.SPECTR

```
      SUBROUTINE SPECTR(TI,EMU,T,F,BETA,ASR,VSR,SV,SVF,SVD,LD)
C
C  THIS SUBROUTINE INTERPOLATES LINEARLY BETWEEN POINTS DEFINED ON THE
C  GROUND SITE VELOCITY SPECTRUM AND THEN MULTIPLIES RESULT-
C  ING SPECTRAL VELOCITY BY A DYNAMIC AMPLIFICATION FACTOR.
C  IF SPECTRAL VELOCITY IS TO BE MODIFIED TO ACCOUNT FOR DUCTILITY,
C  LD .NE. ZERO, THEN THE MODAL PERIOD IS CHANGED AND TWO SEPARATE
C  SPECTRAL VELOCITIES ARE COMPUTED. SVF IS TO BE USED TO COMPUTE ACCELERATION
C  DEPENDENT QUANTITIES INCLUDING FORCE, AND SVD IS TO BE USED TO COMPUTE DIS-
C  PLACEMENT DEPENDENT QUANTITIES INCLUDING DEFLECTION AND PSEUDO VELOCITY.
C
      REAL T(100),F(100)
      IF(LD.EQ.0) GO TO 11
      IF(EMU.LT.1.) GO TO 11
      TI=TI*(.75+ASIN(1./SQRT(2.*EMU-1.))/6.283+SQRT(2.*(EMU-1.))/6.283)
   11 CONTINUE
      IF(TI.LT.T(1)) TI=T(1)
      DO 10 I=1,500
      K=I+1
      IF ((TI.LE.T(K)) .AND. (TI.GE.T(I))) GO TO 15
   10 CONTINUE
   15 Y=F(K)-F(I)
      X=T(K)-T(I)
      IF(X.LT..001) X=0.001
      Z=TI-T(I)
      SLOPE=Y/X
      SV=F(I)+Z*SLOPE
C
C  MODIFY SPECTRAL VELOCITY FOR ELASTIC STRUCTURAL AMPLIFICATION
C
      TA=ALOG10(TI)
      TB=ALOG10(BETA)
  600 FORMAT('0TA = ',E12.4,5X,'TB = 'E12.4)
      IF(TI.LT.0.2) GO TO 20
      AFB=2.18-.147*TA-.633*TB
      GO TO 25
   20 AFB=(2.28-.633*TB)*TI/.2
   25 CONTINUE
      IF(AFB.LT.1.0) AFB=1.0
   23 FORMAT(1H0,2X,'AFB =',E12.4)
   21 FORMAT(1H0,2X,'SV =',E12.4)
      SV=SV*AFB
   22 FORMAT(1H0,2X,'SV*AFB =',E12.4)
      IF (LD.EQ.0) GO TO 140
      IF(EMU.LT.1.) GO TO 140
C
C  MODIFY SPECTRAL VELOCITY FOR DUCTILITY
C
      TA1=6.283*VSR/ASR/386.4
      SREMU=SQRT(EMU)
      TA2=TA1/SREMU
      IF(TI.GT.TA2) GO TO 120
      SVF=SV/SREMU
```

```
      SVD=SV*SREMU
      GO TO 150
  120 IF(TI.GT.TA1) GO TO 130
      SVF=SV*(1.-(TI-TA2)/TA1)/SREMU
      SVD=SV*(1.-(TI-TA2)/TA1)*SREMU
      GO TO 150
  130 SVF=SV/EMU
      SVD=SV
      GO TO 150
  140 CONTINUE
      SVF=SV
      SVD=SV
  150 RETURN
      END
```

@PRT,S READ1

HASSELMAN-T*TPFS.READ1

```
      SUBROUTINE READ1(NB,NS,LC,NBB,NRFJ,NDLC )
      REAL LB(10),LC(30),AB(99),AC(99),IB(99),IC(99),WB(99),WC(99)           14.
      REAL  AL(10),BL(10),FB(99),FC(99)
      INTEGER SUM
      INTEGER BTP(200),CTP(220),BBTP1(200),BBTP2(200)
      REAL ALB(200),BLB(200),SCJB(200),SCKB(200),ALC(220),BLC(220),
     $ SCJC(220),SCKC(220)
      COMMON /DATA/ BTP,CTP,LB,AB,AC,IB,IC,E,WB,WC,ALB,BLB,SCJB,
     $ SCKB,ALC,BLC,SCJC,SCKC,BBTP1,BBTP2,ABR(20)
     $ ,AL,BL,FB,FC,G,EB,GB
      READ(5,9000) E,NB,NBT,NCT,NBB,NBRT,NRFJ,NDLC
9000  FORMAT ( )
      WRITE(6,673)NB,NBB,E
  673 FORMAT('0NUMBER OF BAYS         =',I5,/
     $        '0NUMBER OF BRACED BAYS =',I5,/,
     $        '0YOUNGS MODULUS         =',F9.1,3X,'(KIPS/SQ IN)',/)
      IF(NBT.LE.0) GOTO 73
      WRITE(6,601)                                                            45.
  601 FORMAT('0BEAM TYPE          AB          IB          WB',/)              46.
      DO 2 I=1,NBT                                                            47.
      READ(5,9000)J,AB(J),IB(J),WB(J)
      WRITE(6,602)J,AB(J),IB(J),WB(J)                                         50.
  602 FORMAT(I10,F13.1,F10.1,F10.2)                                           51.
      WB(J) = WB(J)/1000.0/12.0                                               52.
    2 CONTINUE                                                                53.
   73 IF(NCT.LE.0) GOTO 74
      WRITE(6,603)                                                            54.
  603 FORMAT('0COLUMN TYPE        AC          IC          WC',/)              55.
      DO 3 I=1,NCT                                                            56.
      READ(5,9000)J,AC(J),IC(J),WC(J)
      WRITE(6,602)J,AC(J),IC(J),WC(J)                                         58.
      WC(J) = WC(J)/1000.0/12.0                                               59.
    3 CONTINUE                                                                60.
   74 CONTINUE
      IF(NBRT.EQ.0) GOTO 77
      DO 75 I=1,200
      BBTP1(I)=0
   75 BBTP2(I)=0
      WRITE(6,609)
      DO 76 I=1,NBRT
      READ(5,9000) J,ABR(J)
   76 WRITE(6,602) J,ABR(J)
  609 FORMAT ('0BRACE TYPE      ABR',/)
   77 CONTINUE
      WRITE(6,604)
604   FORMAT('0BAY WIDTHS ------',/)
      SUM=0                                                                   67.
    4 READ(5,9000)NUM,BW
      WRITE(6,605)NUM,BW
  605 FORMAT(I6,' BAYS AT',F10.3,' INCHES')                                   71.
      J1=SUM+1                                                                72.
      J2=SUM+NUM                                                              73.
      DO 102 J=J1,J2                                                          74.
```

```
    102 LB(J)=BW                                          75.
        SUM=SUM+NUM                                       76.
        IF(SUM.LT.NB) GOTO 4                              77.
        WRITE(6,606)                                      78.
    606 FORMAT('OSTORY HEIGHTS --------',/)               79.
        SUM=0                                             80.
      5 READ(5,9000) NUM,SH
        WRITE(6,607)NUM,SH                                82.
    607 FORMAT(I6,' STORIES AT',F10.3,' INCHES')          83.
        J1=SUM+1                                          84.
        J2=SUM+NUM                                        85.
        DO 101 J=J1,J2                                    86.
    101 LC(J)=SH                                          87.
        SUM=SUM+NUM                                       88.
        IF(SUM.LT.NS) GOTO 5                              89.
        RETURN
        END                                              250.

@PRT,S  STIFF2
```

```
HASSELM,N-T*TPFS.STIFF2
      SUBROUTINE STIFF2(NS,S,LC)
C
C     THIS SUBROUTINE READS CARD INPUT FOR GENERATING THE STIFFNESS
C     MATRIX OF A STORY MODEL OF A BUILDING AND PRODUCES AN NXN
C     STIFFNESS MATRIX WHERE N = NUMBER OF STORIES.
C
      REAL S(70,70),SK(30),LC(30)
      WRITE(6,10)
   10 FORMAT('0STIFFNESS INPUT FOR STORY MODEL - NBOPT = 2')
      READ(5,9000)(SK(I),I=1,NS)
      READ(5,9000) (LC(I),I=1,NS)
 9000 FORMAT( )
      WRITE(6,30)
   30 FORMAT('0STORY','  STIFFNESS(KIPS/IN)')
      DO 40 I=1,NS
   40 WRITE(6,50)NS,SK(I)
   50 FORMAT(1H ,I5,E20.4)
      WRITE(6,600) (LC(I),I=1,NS)
  600 FORMAT('0STORY HEIGHTS, TOP TO BOTTOM (INCHES)',//,3(1X,1P10E10.2,
     &/))
C
C     COMPUTE STIFFNESS MATRIX S
C
      S(1,1)=SK(1)
      IF(NS.EQ.1) GO TO 62
      S(2,1)=-SK(1)
      NSM1=NS-1
      DO 60 I=2,NSM1
      S(I-1,I)=-SK(I-1)
      S(I,I)=SK(I-1)+SK(I)
      S(I+1,I)=-SK(I)
   60 CONTINUE
      S(NS-1,NS)=S(NS,NS-1)
      S(NS,NS)=SK(NS)+SK(NS-1)
   62 CONTINUE
      RETURN
      END


@PRT,S  STIFF3
```

```
HASSELMAN-T*TPFS.STIFF3
            SUBROUTINE STIFF3(NS,LC,TI,CV,DN)
      C
      C  THIS SUBROUTINE READS THE NUMBER OF STORIES AND STORY HEIGHTS
      C  OF A BUILDING AND ITS FUNDAMENTAL PERIOD, TI. IT THEN COMPUTES MODAL
      C  DEFLECTIONS ASSUMING A STRAIGHT-LINE MODE SHAPE FOR THE FUNDAMENTAL
      C  MODE AND EVALUATES THE FUNDAMENTAL EIGENVALUE BASED ON THE PERIOD
      C  SPECIFIED.
      C
            DIMENSION CV(70),DN(70,70)
            REAL LC(30)
        600 FORMAT('ONUMBER OF STORIES = ',I5)
       9000 FORMAT( )
            READ(5,9000) TI
            WRITE(6,620) TI
        620 FORMAT('OFUNDAMENTAL PERIOD (SEC) =',F8.3)
            READ(5,9000) (LC(I),I=1,NS)
            WRITE(6,610) (LC(I),I=1,NS)
        610 FORMAT('OSTORY HEIGHTS, TOP TO BOTTOM',//,
           63(1X,1P10E10.2,/))
      4     SUM1=0.0
            DO 200 I=1,NS
      200   SUM1=SUM1+LC(I)
            DN(1,1)=1.00
            SUM2=0.0
            DO 201 I=2,NS
            SUM2=SUM2+LC(I-1)
      201   DN(I,1)=1.0*(SUM1-SUM2)/SUM1
            CV(1)=(6.2831853/TI)**2
            RETURN
            END

@PRT,S  LOADS
```

```
HASSELMAN-T*TPF$.LOADS
      SUBROUTINE LOADS(DLAT,DLONG,LRISK,NHAZ,T,F,VF,ISITE,ISHAPE,VT,
     &BL,ITOR,F1,EM)
C
C  THIS SUBROUTINE GENERATES SITE LOADS FOR THREE NATURAL HAZARDS.
C
C     EARTHQUAKE: SITE LOAD IS DEFINED TO BE THE GROUND
C                 PSEUDO-VELOCITY SPECTRUM COMPUTED FROM
C                 A BASE-ROCK SPECTRUM AND MODIFIED BY SITE SOIL
C                 CHARACTERISTICS.
C
C     WIND:       SITE LOAD IS DEFINED TO BE THE FASTEST MILE OF WIND
C                 AT 30 FEET FOR OPEN EXPOSURE.
C
C     TORNADO:    SITE LOAD IS DEFINED IN TERMS OF PROBABILITY OF HIT
C                 AND, IF DESIRED, A NOMINAL TORNADO WIND VELOCITY
C                 SPECIFIED BY THE USER.
C
      INTEGER NHAZ(3)
      REAL T(100),F(100)
      IF(NHAZ(1).EQ.0) GO TO 10
      CALL SEISMC(LRISK,DLAT,DLONG,EM,AR,VR,DR)
      CALL SOILOD(AR,VR,DR,F,T)
   10 IF(NHAZ(2).EQ.0) GO TO 20
      CALL WNDLOD(ISITE,ISHAPE,VF)
   20 IF(NHAZ(3).EQ.0) GO TO 30
      CALL TRNLOD(DLAT,DLONG,VT,ITOR)
   30 CONTINUE
      RETURN
      END
```

@PRT,S DAMPR

```
HASSELMAN-T*TPF$.DAMPR
      SUBROUTINE DAMPR(NDAMP,EMU,ZETA)
      ZETA=2.16+5.2*EMU-.74*EMU**2
      EMUM=5.2/1.44
      ZETAM=2.16+5.2*EMUM-.74*EMUM**2
      IF (EMU.GT.EMUM) ZETA=ZETAM
      IF(NDAMP.EQ.2) ZETA=2.*ZETA
      RETURN
      END
```

@PRT,S STIFF1

HASSELMAN-T*TPFS.STIFF1

```
      SUBROUTINE STIFF1(NOPT,NS,LC,S,M,S,NOPRT)
C
C  THIS SUBROUTINE READS DETAILED STRUCTURAL DATA AND COMPUTES
C  A REDUCED STIFFNESS MATRIX CORRESPONDING TO FLOOR
C  TRANSLATIONS. WHEN NDLC .NE. 1, A MASS VECTOR IS COMPUTED TO
C  ACCOUNT FOR THE MASS OF STEEL FRAMING ONLY.
C
      REAL LB(10),LC(30),AB(99),AC(99),IB(99),IC(99),WB(99),WC(99)
      REAL S(70,70),M(30),
     &     AL(10),BL(10),FB(99),FC(99)
      INTEGER SN,FRN
      INTEGER BTP(200),CTP(220),BBTP1(200),BBTP2(200)
      REAL ALB(200),BLB(200),SCJB(200),SCKB(200),ALC(220),BLC(220),
     & SCJC(220),SCKC(220)
      COMMON /DATA/ BTP,CTP,LB,AB,AC,IB,IC,E,WB,WC,ALB,BLB,SCJB,
     & SCKB,ALC,BLC,SCJC,SCKC,BBTP1,BBTP2,ABR(20)
     & ,AL,BL,FB,FC,G,EB,GB
      REAL ST(30,30),D(30,30)
C*****************************************************************
C  INPUT PARAMETERS
C******************************************************************
      CALL SDATA
      NDIM=70
9000  FORMAT ( )
      FRN=0
      DO 22 I=1,30
      M(I)=0.0
      DO 22 J=1,30
      ST(I,J)=0.0
22    D(I,J)=0.0
      READ(5,9000) NFRMS
      WRITE(6,687) NFRMS
687   FORMAT('0NUMBER OF FRAMES  = ',I5,/)
2     FRN=FRN+1
      READ(5,9000) NOPT
      WRITE(6,686) FRN,NOPT
686   FORMAT('0*** FRAME NO.',I3,' ***','   FRAME MODELING OPTION =',I5,
     &//)
      DO 3 I=1,NDIM
      DO 3 J=1,NDIM
3     S(I,J)=0.0
C**********************************************************
C  DEFINE STRUCTURE PARAMETERS
C**********************************************************
      IF(NOPT.EQ.1) CALL READ1(NB,NS,LC,NBB,NRFJ,NDLC )
      IF(NOPT.EQ.2) CALL READ2(NB,NS,LC,NDLC ,NOPT)
C**********************************************************
C  GENERATE STIFFNESS MATRIX AND FRAMING MASS MATRIX.
C  ELIMINATE VERT. TRANS. AND ROTAT. BY STATIC CONDENSATION
C**********************************************************
      SN=0
6     SN=SN+1
      IF(NOPT.EQ.1) CALL SFRAME(NB,NS,LC,SN,S,NOPRT,NRFJ,NBB)
```

```
      IF(NOPT.EQ.2) CALL GFRAME(NB,NS,LC,SN,S,NOPRT)
      IF(NDLC.EQ.1) GO TO 10
      CALL FRMASS(M,SN,LC,NB,NOPRT)
   10 CONTINUE
      CALL CONDEN(NB,NS,SN,S,$99)
      IF(SN.LT.NS) GOTO 6
      NB2N=(2*NB+2)*2
      DO 5 I=1,NS
      DO 5 J=1,NS
5     S(I,J)=S(I+NB2N,J+NB2N)
C*************************************************************
C  SUPERIMPOSE PLANE FRAME STIFFNESS MATRICES
C*************************************************************
      IF(FRN.EQ.1) GOTO 7
      DO 8 I=1,NS
      DO 8 J=1,NS
      TEMP=ST(I,J)
8     S(I,J)=S(I,J)+TEMP
7     CONTINUE
      DO 9 I=1,NS
      DO 9 J=1,NS
9     ST(I,J)=S(I,J)
      IF(FRN.LT.NFRMS) GOTO 2
      GO TO 100
   99 WRITE(6,700)
  700 FORMAT('1STIFFNESS MATRIX CONDENSATION ERROR. EXECUTION TERMINATED
     &.')
      RETURN 6
  100 RETURN
      END
```

@PRT,S STRUCT

HASSELMAN-T•TPFS•STRUCT

```
      SUBROUTINE STRUCT(NMOD,NS,LC,TWB,TLB,PHR,NOPRT,$,M,S,E,C,D)
C
C  THIS SUBROUTINE READS DATA DESCRIBING THE STRUCTURAL PROPERTIES OF A
C  BUILDING AND THE MODELING OPTION TO BE USED.
C  THREE OPTIONS ARE AVAILABLE:
C
C      NMOD = 1: DETAILED STRUCTURAL MODEL - ALL STRUCTURAL
C                ELEMENTS MUST BE SPECIFIED INCLUDING BEAMS,
C                COLUMNS, BRACING, STRUCTURAL WALLS, FLOOR WEIGHTS, ETC.
C
C      NMOD = 2: STORY STIFFNESS MODEL - ESTIMATED STORY
C                STIFFNESSES ARE SPECIFIED ALONG WITH FLOOR
C                WEIGHTS
C
C      NMOD = 3: EMPERICAL MODAL - THE FUNDAMENTAL PERIOD
C                OF THE BUILDING IS SPECIFIED AND A STRAIGHT-LINE
C                MODE SHAPE IS ASSUMED.
C
C  FOR NMOD = 1&2, AN NS X NS EIGENPROBLEM IS SOLVED WHERE NS EQUALS
C  THE NUMBER OF STORIES OF THE BUILDING.
C
      REAL M(30),C(70),D(70,70),LC(30),S(70,70),A(100),B(100),
     &PP(100),MT(30),E(30,30)
      WRITE(6,700)
  700 FORMAT(1H1,23X,'S T R U C T U R A L   A N A L Y S I S',///)
      READ (5,9000) NS,TWB,TLB,PHR,NOPRT
      WRITE(6,610) NS,TWB,TLB,PHR
  610 FORMAT('0NUMBER OF STORIES = ',I5,/,
     &       '0TOTAL BUILDING WIDTH (INCHES) = ',F7.1,/,
     &       '0TOTAL BUILDING LENGTH (INCHES) = ',F7.1,/,
     &       '0HEIGHT OF PARAPET (INCHES)     = ',F7.1,/)
 9000 FORMAT ( )
      IF (NMOD.NE.3) GO TO 10
      CALL STIFF3 (NS,LC,TI,C,D)
      GO TO 150
   10 IF (NMOD.NE.2) GO TO 20
      CALL STIFF2 (NS,S,LC)
      GO TO 30
   20 IF (NMOD.NE.1) GO TO 40
      CALL STIFF1 (NOPT,NS,LC,S,M,$99,NOPRT)
   30 DO 25 I=1,NS
      DO 25 J=1,NS
   25 E(I,J)=S(I,J)
      WRITE(6,603)
  603 FORMAT('1STIFFNESS MATRIX (KIPS/IN)',/)
      CALL MATPRT(NS,NS,S)
      CALL FLMASS (NS,M)
      DO 60 I=1,NS
   60 C(I)=M(I)*386.4
      WRITE(6,604)
  604 FORMAT('1TOTAL WEIGHT VECTOR (KIPS)',/)
      CALL MATPRT(NS,1,C)
      CALL EIGENS (S,MT,M,C,D,NS,A,B,PP)
```

```
      DO 35 I=1,NS
      DO 35 J=1,NS
   35 S(I,J)=E(I,J)
      GO TO 50
  150 CONTINUE
      CALL FLMASS(NS,M)
      WRITE(6,604)
      DO 151 I=1,NS
  151 A(I)=M(I)*386.4
      CALL MATPRT(NS,1,A)
      GO TO 50
   40 WRITE (6,600)
  600 FORMAT ('1STRUCTURAL MODELING OPTION IMPROPERLY SPECIFIED.
     &         EXECUTION TERMINATED.')
   99 RETURN 8
   50 RETURN
      END

@PRT,S  DYNAMC
```

```
HASSELMAN-T*TPFS.DYNAMC
      SUBROUTINE DYNAMC(N,LC,S,C,D,M,ASR,VSR,T,F,E,LD,NOPRT,
     &NMOD)
C
C
C  THIS SUBROUTINE COMPUTES THE DYNAMIC RESPONSE OF A BUILDING
C  TO A SEISMIC LOAD ENVIRONMENT CHARACTERIZED BY THE GROUND
C  SITE RESPONSE SPECTRUM. AN INITIAL VALUE OF STRUCTURAL DAMPING
C  IS COMPUTED, AND SUBSEQUENTLY UPDATED BY SUBROUTINE DAMPR
C  IN AN ITERATIVE MANNER UNTIL THE AMOUNT OF DAMPING IS CONSISTENT
C  WITH THE AMPLITUDE OF MOTION FOR THE TYPE OF STRUCTURE SPECIFIED.
C
      REAL T(100),F(100),C(70),D(70,70),S(70,70),DEFLY(30),DMU(30),
     &     M(30),W(30),V(30),E(30,30),MR,EE(30,24)/720*0.0/,DRFTY(30),
     &     LC(30),DISP(30)
      WRITE(6,700)
  700 FORMAT(1H1,20X,'E A R T H Q U A K E   R E S P O N S E   A N A L Y
     &S I S',///)
C
C  READ CONTL. VARS., STORY DRIFT TO YIELD, AND COMPUTE MODAL PARAMETERS.
C
      READ(5,9000) NDAMP,ITERMX,LD,MCOP
 9000 FORMAT( )
      WRITE(6,607) NDAMP,ITERMX,LD
      WRITE(6,610) MCOP
  610 FORMAT('0MODAL COMBINATION OPTION = ',I5)
  607 FORMAT('0DAMPING CURVE OPTION =',I5,/,
     &'0MAXIMUM NUMBER ITERATIONS =',I5,/,
     &'0MODIFY RESPONSE FOR DUCTILITY =',I5)
      EBETA=.05
      EEMU=.05
      READ(5,9000) (DRFTY(I),I=1,N)
      WRITE(6,650) (DRFTY(I),I=1,N)
  650 FORMAT('0EFFECTIVE INTERSTORY DRIFT TO YIELD BY STORY (IN/IN)',//,
     &3(1X,1P10E13.2,/))
      EMU=1.0
      CALL DAMPR(NDAMP,EMU,BETA)
      WRITE (6,606) BETA
      NR=3
      N9=N
      IF(N.GT.6) N9=6
      IF(NMOD.EQ.3) N9=1
      ITER=0
   20 CONTINUE
      WRITE(6,600)
      TM=0.0
      ITER=ITER+1
      DO 8 I=1,N
    8 TM=TM+M(I)
      DO 2 I=1,N9
      SUM1=0.0
      SUM2=0.0
      SUM3=0.0
      DO 1 J=1,N
```

```
      SUM2=SUM2+D(J,I)**2*M(J)
    1 SUM3=SUM3+D(J,I)*M(J)
      SUM1=SUM3**2
      A(I)=SUM1/SUM2
      TI=6.2831853/SQRT(C(I))
      CALL SPECTR(TI,EMU,T,F,BETA,ASR,VSR,SV,SVF,SVD,LD)
      C(I)=(6.283/TI)**2
      FI=1.0/TI
      V(I)=W(I)*2.0*3.1416*SVF/TI
      AR=SUM2/SUM3
      MR=W(I)/TM
      WRITE(6,601) I,FI,TI,MR,SV,V(I),AR,SVF,SVD
      W(I)=SVD*TI/6.283185/AR
    2 E(N,I)=SUM3
  606 FORMAT('0CRITICAL DAMPING (PERCENT) =',F8.2)
C
C  COMPUTE MODAL RESPONSE
C
      DO 7 I=1,N9
      DO 7 J=1,N
    7 E(J,I)=V(I)*D(J,I)*M(J)/E(N,I)
      DO 5 I=1,N9
      IF(NOPRT.NE.1) WRITE(6,602) I
      SUM1=0
      DO 3 J=1,N
      SUM1=SUM1+E(J,I)
      SUM2=D(J,I)*W(I)
      IF(J.EQ.N) SUM3=SUM2
      IF(J.NE.N) SUM3=SUM2-D(J+1,I)*W(I)
      SUM3=ABS(SUM3)
      IF(I.GT.6) GOTO 31
      II=I+6
      EE(J,II)=SUM3
      II=I+12
      EE(J,II)=SUM2*SQRT(C(I))
      II=I+18
      EE(J,II)=E(J,I)/M(J)/386.4
      IF (NOPRT.EQ.1) GO TO 3
   31 WRITE(6,603) J,E(J,I),SUM1,SUM2,SUM3,EE(J,I+12),EE(J,I+18)
    3 E(J,I)=SUM1
    5 CONTINUE
C
C  COMPUTE TOTAL RESPONSE
C
      GO TO (110,120,130), MCOP
  110 DO 111 I=1,N
      EE(I,4)=EE(I,7)
      EE(I,5)=EE(I,13)
  111 EE(I,6)=EE(I,19)
      GO TO 140
  120 DO 121 I=1,N
      SUM1=0.
      SUM2=0.
      SUM3=0.
```

```
      DO 122 J=1,N9
      SUM1=SUM1+EE(I,J+6)**2
      SUM2=SUM2+EE(I,J+12)**2
  122 SUM3=SUM3+EE(I,J+18)**2
      EE(I,4)=SQRT(SUM1)
      EE(I,5)=SQRT(SUM2)
  121 EE(I,6)=SQRT(SUM3)
  130 DO 131 I=1,N
      SUM1=0.
      SUM2=0.
      SUM3=0.
      DO 132 J=1,N9
      SUM1=SUM1+ABS(EE(I,J+6))
      SUM2=SUM2+ABS(EE(I,J+12))
  132 SUM3=SUM3+ABS(EE(I,J+18))
      EE(I,4)=SUM1
      EE(I,5)=SUM2
  131 EE(I,6)=SUM3
  140 CONTINUE
      WRITE(6,199)
  199 FORMAT('O STORY           I. S. DEFL           VELOCITY            AC
     &CELERATION',/,
     &'   NO.              (IN)                (IN/SEC)                 (G)',/
     &)
      DO 200 I=1,N
  200 WRITE(6,665) I,EE(I,4),EE(I,5),EE(I,6)
  665 FORMAT(I4,1X,1P3E20.4)
C
C  COMPUTE DUCTILITY BY STORY AND EFFECTIVE DUCTILITY FOR BUILDING
C
      EMU1=EMU
      DO 150 I=1,N
  150 DMU(I)=EE(I,4)/LC(I)/DRFTY(I)
      WRITE(6,670) (DMU(I),I=1,N)
  670 FORMAT('ODUCTILITY BY STORY',//,3(1X,1P10E10.2,/))
      DISP(N)=EE(N,4)
      DEFLY(N)=DRFTY(N)*LC(N)
      DO 210 I=2,N
      II=N+1-I
      DISP(II)=DISP(II+1)+EE(II,4)
  210 DEFLY(II)=DEFLY(II+1)+DRFTY(II)*LC(II)
      IF(NMOD.EQ.3) GO TO 180
      DO 160 I=1,N
      V(I)=0.
      W(I)=0.
      DO 160 J=1,N
      V(I)=V(I)+S(I,J)*DISP(J)
  160 W(I)=W(I)+S(I,J)*DEFLY(J)
      SUM1=0.
      SUM2=0.
      DO 170 I=1,N
      SUM1=SUM1+DISP(I)*V(I)
  170 SUM2=SUM2+DEFLY(I)*W(I)
      EMU=SQRT(SUM1/SUM2)
```

```
      GO TO 190
  180 CONTINUE
      SUM1=0.
      DO 181 I=1,N
  181 SUM1=SUM1+DMU(I)
      EMU=SUM1/N
  190 WRITE(6,680) EMU
  680 FORMAT('0EFFECTIVE DUCTILITY FOR BUILDING = ',F6.2)
      IF(ITER.GE.ITERMX) GO TO 11
      BETA1=BETA
      CALL DAMPR(NDAMP,EMU,BETA)
      WRITE(6,606) BETA
C
C  TEST FOR CONVERGENCE OF DUCTILITY AND DAMPING
C
      IF(LD.EQ.0) GO TO 10
      IF(ABS(1.-EMU/EMU1).GT.EEMU) GO TO 20
   10 CONTINUE
      IF (ABS(1.0-BETA/BETA1).GT.EBETA) GO TO 20
   11 CONTINUE
C
C  PRINT FINAL RESPONSE CALCULATIONS.
C
      IF(NOPRT.EQ.1) GO TO 91
      DO 51 I=1,N
      IF(NOPT.EQ.3) GOTO 91
      SUM=0.0
      SUM1=0.0
      SUM2=0.0
      DO 4 J=1,N
      SUM2=SUM2+ABS(E(I,J))
      SUM1=SUM1+E(I,J)**2
    4 CONTINUE
      EE(I,2)=SQRT(SUM1)
      EE(I,3)=SUM2
   51 EE(I,1)=E(I,1)
      DO 30 K=1,NR
      WRITE(6,604) K
      DO 30 I=1,N
      IF (I.EQ.1) SUM1=EE(I,K)
      IF (I.GT.1) SUM1=EE(I,K)-EE(I-1,K)
   30 WRITE(6,605) I,SUM1,EE(I,K)
  600 FORMAT ('1',/,
     *'   MODE  FREQUENCY PERIOD  MASS  PSUDO-SPECTRAL   MAXIMUM',
     *'   AMPLITUDE      PS.SPECT.VEL. MODIFIED FOR DUCTILITY',/,
     *'    NO.     (CPS)   (SEC.)  RATIO   VELOCITY     BASE SHEAR',
     *'    RATIO       (ACCEL)      (DISPL)',/)
  601 FORMAT(I4,F12.4,2F7.3,F11.3,F15.3,F11.3,2F11.3)
  602 FORMAT ('1',/,
     *'     EFFECTIVE FORCE FOR MODE NO.',I4,//,
     *' STORY    FORCE(KIPS)   SHEAR(KIPS)   DEFLECTION   STORY DRIFT',
     &'   VELOCITY  ACCELERATION',/)
  603 FORMAT(I5,F12.3,F14.3,4F14.4)
  604 FORMAT ('1',/,
```

```
     *'   COMBINED FORCE FOR ALL MODES (METHOD',I5,')',/,/,
     *' STORY   FORCE(KIPS)   SHEAR(KIPS)',/)
 605 FORMAT(I5,F12.3,F14.3)
  91 CONTINUE
     DO 9 I=1,N
     DO 9 J=1,24
   9 E(I,J)=EE(I,J)
     RETURN
     END
```

```
@PRT,S  STAT,C
```

```
HASSELMAN-T*TPF$.STATIC
      SUBROUTINE STATIC(NHAZ,NS,S,LC,TWB,PHR,TI,DRFT,VT,
     &DN,VF,M,CEC,CIC,QMS,VMM,ISHAPE,ISITE,NMOD,ITOR,ITYPE)
C
C  THIS SUBROUTINE COMPUTES THE STATIC RESPONSE OF A BUILDING
C  TO WIND PRESSURE DISTRIBUTIONS.
C
      REAL S(70,70),LC(30),DRFT(30),DF(30),WF(30),M(30),DN(70,70)
      REAL CEC(10),CIC(10),QMS(30),VMM(30)
      INTEGER NHAZ(3)
      WRITE(6,700)
  700 FORMAT(1H1,20X,'W I N D   R E S P O N S E   A N A L Y S I S',
     &///)
      IF((ITOR.EQ.-1).AND.(NHAZ(2).NE.0)) GO TO 23
      IF(NMOD.EQ.3) GOTO 23
C
C  INVERT STIFFNESS MATRIX
C
      CALL DECOMP(NS,S,&99)
      CALL INVERS(NS,S)
   23 CONTINUE
      TM=0.
      DO 10 I=1,NS
   10 TM=TM+M(I)
C
C  COMPUTE PRESSURE FORCES FOR EACH STORY
C
      IF(ITOR.EQ.-1) GO TO 16
      CALL WIND(LC,NS,TWB,TM,TI,CEC,CIC,QMS,VMM,WF,ISHAPE,ISITE,VF,ITYPE
     &)
      GO TO 17
   16 CONTINUE
      WRITE(6,750)
  750 FORMAT(1H0,20X,'W I N D  D U E  T O  T O R N A D O',///)
      CALL TRNADO(VT,LC,NS,WF,TWB,CEC,CIC,QMS,VMM)
  900 FORMAT(1P10E10.2)
   17 IF(NMOD.EQ.3) GOTO 24
      GOTO 25
C
C  COMPUTE WIND DEFLECTIONS FOR EMPERICAL MODEL
C
24    SUM1=0.0
      SUM2=0.0
      DO 26 I=1,NS
      SUM1=SUM1+M(I)*386.4
26    SUM2=SUM2+WF(I)
      DO 27 I=1,NS
27    DF(I)=DN(I,1)*(3.89*TI)**2*(SUM2/SUM1)
      GOTO 28
C
C  COMPUTE WIND DEFLECTIONS FOR OTHER MODELS
C
25    DO 34 I=1,NS
      TEMP=0.0
```

```
      DO 35 J=1,NS
   35 TEMP=TEMP+S(I,J)*WF(J)
   34 DF(I)=TEMP
   28 SUM2=0.0
C
C  COMPUTE STORY DRIFT AND SHEAR
C
      WRITE(6,657)
  657 FORMAT('1WIND ANALYSIS',/,
     &       '0STORY  DEFLECTION  DRIFT    STORY SHEAR',/,
     &       '  NO.    (INCHES)  (IN/IN)     (KIPS)',/)
      DO 36 I=1,NS
      SUM2=SUM2+WF(I)
      IF(I.EQ.NS)GOTO 37
      DRFT(I)=ABS(DF(I)-DF(I+1))
      GOTO 38
   37 DRFT(NS)=ABS(DF(NS))
   38 DRFT(I)=DRFT(I)/LC(I)
      WRITE(6,658) I,DF(I),DRFT(I),SUM2
  658 FORMAT(I4,F12.3,F9.4,F11.2)
   36 CONTINUE
      RETURN
   99 WRITE(6,660)
  660 FORMAT('0STIFFNESS MATRIX IS SINGULAR')
      RETURN 18
      END
```

@PRT,S DAMAG

HASSELMAN-T*TPF$.DAMAG

```
      SUBROUTINE DAMAG(NHAZ,EM,AR,VR,NS,A,V,EDEFL,LC,T1,DRFT,
     &CEC,CIC,QMS,VMH,ITOR,LSROPT,IFLY,IW)
C
C  THIS SUBROUTINE COMPUTES THE PERCENT DAMAGE TO BUILDINGS
C  DUE TO EARTHQUAKE AND WIND ENVIRONMENTS. DAMAGE CATEGORIES
C  INCLUDE STRUCTURAL, NONSTRUCTURAL AND GLASS.
C
      REAL A(30),V(30),DMU(3),DRFT(30),DMUC(3)
      REAL DMUF(30,3),EDEFL(30),LC(30)
      INTEGER NHAZ(3)
      REAL HW(30),BW(30),Q(30),DC(30),DST(3),THG(30)
      REAL CEC(10),CIC(10),QMS(30),VMH(30),DGA(5)
      REAL DELTY(30,3),CVDY(30,3),CVDMUF(30,3),CVDLTG(30)
      REAL DELTYP(30),CVDYP(30),CVPZR(30)
  622 FORMAT ('0DRIFT TO YIELD BY STORY (FRAME)',//,
     & 3(1X,1P10E10.2,/))
  623 FORMAT ('0COEFFICIENT OF VARIATION BY STORY',//,
     & 3(1X,1P10E10.2,/))
  632 FORMAT ('0DRIFT TO YIELD BY STORY (WALL)',//,
     & 3(1X,1P10E10.2,/))
  642 FORMAT ('0DRIFT TO YIELD BY STORY (DIAPHRAGM)',//,
     & 3(1X,1P10E10.2,/))
  687 FORMAT ('0DRIFT TO YIELD BY STORY (PARTITIONS)',//,
     & 3(1X,1P10E10.2,/))
  600 FORMAT('0QUALITY FACTOR OF CONSTRUCTION BY STORY',//,
     & 3(1X,1P10E10.2,/))
  620 FORMAT('0DUCTILITY TO FAILURE BY STORY (FRAME)',//,
     & 3(1X,1P10E10.2,/))
  630 FORMAT('0DUCTILITY TO FAILURE BY STORY (WALL)',//,
     & 3(1X,1P10E10.2,/))
  640 FORMAT('0DUCTILITY TO FAILURE BY STORY (DIAPHRAGM)',//,
     & 3(1X,1P10E10.2,/))
  670 FORMAT('0MEAN BREAKING STRESS OF GLASS',//,1X,1P10E10.2)
 9000 FORMAT( )
  682 FORMAT('0HEIGHT OF WINDOWS BY STORY (INCHES)',//,3(1X,1P10E10.2,/)
     &)
  683 FORMAT('0WIDTH OF WINDOWS BY STORY (INCHES)',//,3(1X,1P10E10.2,/))
  684 FORMAT('0AVERAGE CLEARANCE IN MULLIONS (INCHES)',//,3(1X,1P10E10.2
     &,/))
  685 FORMAT('0THICKNESS OF WINDOW GLASS BY STORY (INCHES)',//,
     & 3(1X,1P10E10.2,/))
      WRITE(6,8000)
 8000 FORMAT(1H1,20X,'D A M A G E   A N A L Y S I S',///)
      IF(ITOR.EQ.-1) GO TO 41
C
C  READ DAMAGEABILITY INPUTS FOR EQUAKE, WIND, OR TORNADO
C
      READ(5,9000) (DELTY(I,1),I=1,NS)
      WRITE(6,622) (DELTY(I,1),I=1,NS)
      READ(5,9000) (CVDY(I,1),I=1,NS)
      WRITE(6,623) (CVDY(I,1),I=1,NS)
      READ(5,9000) (DELTY(I,2),I=1,NS)
      WRITE(6,632) (DELTY(I,2),I=1,NS)
```

```
      READ(5,9000) (CVDY(I,2),I=1,NS)
      WRITE(6,623) (CVDY(I,2),I=1,NS)
      READ(5,9000) (DELTY(I,3),I=1,NS)
      WRITE(6,642) (DELTY(I,3),I=1,NS)
      READ(5,9000) (CVDY(I,3),I=1,NS)
      WRITE(6,623) (CVDY(I,3),I=1,NS)
      READ(5,9000) (HW(I),I=1,NS)
      WRITE(6,682) (HW(I),I=1,NS)
      READ(5,9000) (BW(I),I=1,NS)
      WRITE(6,683) (BW(I),I=1,NS)
      IF(NHAZ(1).EQ.0) GO TO 10
C
C  READ DAMAGEABILITY INPUTS FOR EQUAKE ONLY
C
      READ(5,9000)(DMUF(I,1),I=1,NS)
      WRITE(6,623)(DMUF(I,1),I=1,NS)
      READ(5,9000) (CVDMUF(I,1),I=1,NS)
      WRITE(6,623) (CVDMUF(I,1),I=1,NS)
      READ(5,9000)(DMUF(I,2),I=1,NS)
      WRITE(6,630)(DMUF(I,2),I=1,NS)
      READ(5,9000) (CVDMUF(I,2),I=1,NS)
      WRITE(6,623) (CVDMUF(I,2),I=1,NS)
      READ(5,9000)(DMUF(I,3),I=1,NS)
      WRITE(6,640)(DMUF(I,3),I=1,NS)
      READ(5,9000) (CVDMUF(I,3),I=1,NS)
      WRITE(6,623) (CVDMUF(I,3),I=1,NS)
      READ(5,9000) (Q(I),I=1,NS)
      WRITE(6,600) (Q(I),I=1,NS)
      READ(5,9000) (DC(I),I=1,NS)
      WRITE(6,684) (DC(I),I=1,NS)
      READ(5,9000) (CVDLTG(I),I=1,NS)
      WRITE(6,623) (CVDLTG(I),I=1,NS)
   10 CONTINUE
      IF((NHAZ(2).EQ.0).AND.(NHAZ(3).EQ.0)) GO TO 15
C
C  READ DAMAGEABILITY INPUTS FOR WIND OR TORNADO ONLY
C
      READ(5,9000) (DELTYP(I),I=1,NS)
      WRITE(6,687) (DELTYP(I),I=1,NS)
      READ(5,9000) (CVDYP(I),I=1,NS)
      WRITE(6,623) (CVDYP(I),I=1,NS)
      READ(5,9000) (THG(I),I=1,NS)
      WRITE(6,685) (THG(I),I=1,NS)
      READ(5,9000) SGB
      WRITE(6,670) SGB
      READ(5,9000) (CVPZR(I),I=1,NS)
      WRITE(6,623) (CVPZR(I),I=1,NS)
   15 CONTINUE
C
C  COMPUTE EARTHQUAKE DAMAGE FOR EACH FLOOR
C
      IF(NHAZ(1).EQ.0)GO TO 42
C
C  STRUCTURAL DAMAGE
```

```
C
      WRITE(6,699)
  699 FORMAT('1STRUCTURAL DAMAGE DUE TO EARTHQUAKE (PERCENT)',//,
     & ' STORY                FRAME            WALL             DIAPHRAGM',/,
     & '  NO.                 DAMAGE           DAMAGE           DAMAGE',//)
  700 FORMAT(I4,6X,5X,F10.2,5X,F10.2,5X,F10.2,4F10.2)
      DO 20 I=1,NS
      DO 30 J=1,3
      DMUC(J) = T1*DMUF(I,J)/.0046/(10.**(.434*EM))
      IF(DMUC(J).LT.1.0) DMUC(J)=1.0
      IF(DMUC(J).GT.DMUF(I,J)) DMUC(J)=DMUF(I,J)
      DMU(J)=EDEFL(I)/LC(I)/DELTY(I,J)
   31 X=(DMU(J)/DMUC(J)-1.)/CVDMUF(I,J)
      DST(J)=RNORM(X)*100.
   30 CONTINUE
      WRITE(6,700) I,DST(1),DST(2),DST(3)
   20 CONTINUE
   25 CONTINUE
C
C  NONSTRUCTURAL DAMAGE INCLUDING GLASS
C
      WRITE(6,709)
  709 FORMAT('0NONSTRUCTURAL DAMAGE DUE TO EARTHQUAKE (PERCENT)',//,
     & ' STORY   MMI        MMI        MMI      MULLION   NONSTR    GLASS
     &',/,
     & '  NO.    (A)        (V)       (A,V)      DRIFT    DAMAGE    DAMAGE
     &',//)
  710 FORMAT(I4,4X,F4.1,6X,F4.1,6X,F4.1,4X,1PE8.2,0P6F10.2)
      DO 40 I=1,NS
      AMMI = 3.5*ALOG10(A(I))+10.28
      BMMI = 2.73*ALOG10(V(I))+5.16
      EMMI = AMAX1(AMMI , BMMI)
      X = -4.62 + .552*EMMI*(1.-(Q(I)-3.)/6.)
      DNST = 10.**X
      IF(DNST.GT.100.) DNST=100.
      DRFTG = 2.*DC(I)/HW(I)*(1.+HW(I)/BW(I))
      Y=EDEFL(I)/LC(I)
      X = (Y/DRFTG - 1.)/CVDLTG(I)
      DG = RNORM(X)*100.
      WRITE (6,710)I,AMMI,BMMI,EMMI,Y,DNST,DG
   40 CONTINUE
   42 CONTINUE
C
C  COMPUTE WIND DAMAGE FOR EACH FLOOR
C
      IF(NHAZ(2).EQ.3) GO TO 125
   41 CONTINUE
C
C  STRUCTURAL DAMAGE
C
      WRITE(6,719)
  719 FORMAT('1STRUCTURAL DAMAGE DUE TO WIND (PERCENT)',//,
     & ' STORY                FRAME            WALL             DIAPHRAGM',/,
     & '  NO.                 DAMAGE           DAMAGE           DAMAGE',//)
```

```
  720 FORMAT(I5,14X,F6.2,9X,F6.2,9X,F6.2)
      DO 100 I=1, NS
      DO 110 J=1,3
  111 X = (DRFT(I)/DELTY(I,J)-1.)/CVDY(I,J)
  113 DST(J) = 100.*RNORM(X)
  110 CONTINUE
      WRITE(6,720) I,DST(1),DST(2),DST(3)
  100 CONTINUE
C
C  NONSTRUCTURAL DAMAGE - PARTITIONS AND GLASS
C
      WRITE(6,729)
  729 FORMAT('1NONSTRUCTURAL DAMAGE DUE TO WIND (PERCENT)',//,
     &  ' STORY               PARTITIONS       GLASS DAMAGE DUE TO DIRECT PR
     &ESSURE',/,
     &  '  NO.                DAMAGE           WALL 1           WALL 2
     & WALL 3          WALL 4          CORNERS',//)
  730 FORMAT(I5,14X,F6.2,5(9X,F6.2))
  900 FORMAT(1P10E10.2)
      DO 120 I=1,NS
      X = (DRFT(I)/DELTYP(I)-1.)/CVDYP(I)
      DNST = 100.*RNORM(X)
      AA = AMIN1(HW(I),BW(I))
      BB = AMAX1(HW(I),BW(I))
      PZR = SGB*THG(I)**2*(1.+1.61*(AA**3/BB**3))/.75/AA**2
      DO 119 J=1,5
      P=CEC(J)*QMS(I)-CIC(J)*VMH(I)
      P=ABS(P)/144.
      X=(P/PZR-1.)/CVPZR(I)
  119 DGA(J)=100.*RNORM(X)
      WRITE(6,730) I,DNST,(DGA(J),J=1,5)
  120 CONTINUE
  125 CONTINUE
      IF(LSROPT.EQ.0) GO TO 500
C
C  LONG SPAN ROOF DAMAGE
C
      WRITE(6,800)
      IF(IFLY.NE.0)WRITE(6,810)
      IF(IW.NE.0) WRITE(6,820)
      IF((IFLY.EQ.0).AND.(IW.EQ.0)) WRITE(6,830)
  800 FORMAT('0DAMAGE TO LONG-SPAN ROOF',//)
  810 FORMAT(10X,'ROOF TIE-DOWN SUPPORTS ARE INADEQUATE TO RESIST ',/,
     &' NET UPLIFT PRESSURE DUE TO WIND. PREDICT ROOF SEPARATION.',/)
  820 FORMAT(10X,'ROOF DESIGN IS INADEQUATE TO SUPPORT DEAD WEIGHT',/,
     &10X,'DUE TO PONDING. PREDICT COLLAPSE.',/)
  830 FORMAT(10X,'TIE-DOWN CAPACITY AND DEAD WEIGHT CAPACITY ARE',/,
     &10X,'ADEQUATE TO RESIST PREDICTED LEVELS OF NET UPLIFT',/,
     &10X,'DUE TO WIND, AND COLLAPSE DUE TO PONDING (IF ANY).',/,
     &10X,'NO DAMAGE IS PREDICTED.')
  500 RETURN
      END
```

```
HASSELMAN-T*TPFS.SEISMC
      SUBROUTINE SEISMC(LRISK,DLAT,DLONG,EM,AR,VR,DR)
C
C  THIS SUBROUTINE READS SEISMICITY DATA OBTAINED FROM
C  TABLES AND COMPUTES HARD ROCK ACCELERATION, VELOCITY AND
C  DISPLACEMENT CHARACTERISTICS.
C
  610 FORMAT('0MEAN SEISMICITY    =',1PE10.3,5X,
     &'STANDARD DEVIATION =',1PE10.3)
  620 FORMAT('0PROBABILITY THAT EARTHQUAKE OF MAGNITUDE',F5.1,2X,/,
     &1X,'OR LARGER WILL NOT OCCUR DURING A PERIOD OF',F7.1,2X,
     &'YEARS =',F6.3)
  630 FORMAT('0SELECTED SEISMICITY:  MEAN PLUS',F5.1,2X,
     &'SIGMA =',F5.1)
 9000 FORMAT( )
      WRITE(6,700)
  700 FORMAT(1H1,20X,'E A R T H Q U A K E   L O A D   A N A L Y S I S',///
     &)
      IF(LRISK.NE.0) GO TO 10
      READ(5,9000) EM,RBAR
      GO TO 100
   10 CONTINUE
      READ(5,9000) LP
      IF(LP.NE.0) GO TO 20
      READ(5,9000) RNI
      RN=1./RNI
      GO TO 30
   20 CONTINUE
      READ(5,9000) BLIFE,PNOC
      RN=ALOG(1./PNOC)/BLIFE
   30 CONTINUE
      READ(5,9000) A,ASIG,RBAR
      WRITE(6,610) A,ASIG
      EM=(A-ALOG10(RN))/.9
      IF(LP.EQ.0) WRITE(6,621) EM,RNI
  621 FORMAT('0RETURN PERIOD FOR EARTHQUAKE OF MAGNITUDE',F6.2,
     &2X,' = ',F8.1,2X,'YEARS')
      IF(LP.NE.0) WRITE(6,620)EM,BLIFE,PNOC
      READ(5,9000) ENSIG,EMMAX
      A=A+ENSIG*ASIG
      WRITE(6,630) ENSIG,A
      EM=(A-ALOG10(RN))/.9
      IF(EM.GT.EMMAX) EM=EMMAX
  100 CONTINUE
C
C  COMPUTE HARD ROCK GROUND MOTION
C
      READ(5,9000) LCOP
      IF(LCOP.EQ.0) GO TO 110
      WRITE(6,640)
  640 FORMAT('0USER INPUT CONSTANTS FOR COMPUTING HARD ROCK GROUND MOTIO
     &N',//)
      READ(5,9000) C1,C2,C3
      READ(5,9000) CA1,CA2

@PRT,S  SEISMC
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```
      READ(5,9000) CD1,CD2
      WRITE(6,650) C1,C2,C3,CA1,CA2,CD1,CD2
  650 FORMAT(1X,1P10E10.2)
      GO TO 120
  110 CONTINUE
      IF(DLONG.GT.105.)GO TO 115
      C1=.00867
      C2=.563
      C3=.979
      GO TO 116
  115 C1=.0237
      C2=.563
      C3=1.403
  116 CONTINUE
      CA1=-1.5675
      CA2=0.7718
      CD1=-0.6144
      CD2=1.1438
  120 VR=C1*10.**(C2*EM)*RBAR**(-C3)
      AA=CA1+CA2*ALOG10(VR)
      DD=CD1+CD2*ALOG10(VR)
      AR=10.**AA
      DR=10.**DD
      WRITE(6,660) EM,RBAR,AR,VR,DR
  660 FORMAT('0HARD ROCK GROUND MOTION CHARACTERISTICS',//,
     &10X,'RICHTER MAGNITUDE               =',1PE10.2,/,
     &10X,'HYPOCENTRAL DISTANCE (MILES) =',1PE10.2,/,
     &10X,'HARD ROCK ACCELERATION (G)    =',1PE10.2,/,
     &10X,'HARD ROCK VELOCITY (IN/SEC)   =',1PE10.2,/,
     &10X,'HARD ROCK DISPLACEMENT (IN)   =',1PE10.2)
      RETURN
      END

@PRT,S  SDYN
```

HASSELMAN-T*TPF$.SDYN

```
      SUBROUTINE SDYN(AMP,SIG)
C     AMSPCH      NOV 67
C  COMPUTES AND PLOTS AMPLIFICATION SPECTRA FOR LAYERED SITES
C    USES HYSTERESIS MODEL  WITH CONSTANT PHASE ANGLE  PHI
      DIMENSION XJ(4,4),XP(4,4),Y(4),Z(2,3),AMPRAT(2)
C   DIMENSIONED FOR 20 LAYERS PLUS BEDROCK  TO INCREASE THE MAXIMUM
C   NUMBER OF LAYERS, CHANGE THE FOLLOWING DIMENSION CARDS
      DIMENSION THICK(21),DENSI(21),VELOC(21),PHI(21),
     1 RHO(21),PCPE(21),PCIM(21),APFREQ(21),APPAMP(21)
      REAL AMP(100)
C  SET CONSTANTS
      KOUNT=0
      PI = 3.1415926
      THETO = 1.0E+08
      STEP=0.1
      START=0.1
      IRANGE=100
C     INPUT THE TYPE OF ANALYSIS ** DYNAMIC OR PSUDEO DYNAMIC **
C     AND THE NUMBER OF LAYERS ** MAXIMUM NUMBER IS 20
      READ(5,1) ITYPE,N
    1 FORMAT( )
C  INPUT THE THICKNESS, UNIT WEIGHT, VELOCITY, AND PHASE ANGLE OF EACH LAYER
C  CARDS MUST BE IN ASCENDING ORDER WITH BEDROCK FIRST AND THE TOP LAYER LAST
      TI=0.0
      HI=0.0
      VAV=0.0
      WAV=0.0
      M = N+1
      IF (ITYPE.EQ.1) GO TO 2
      CALL EDYN(VELOC,THICK,DENSI,PHI,N,0,APFREQ)
      GO TO 3
    2 DO 10 K=2,M
      READ (5,1) THICK(K),DENSI(K),VELOC(K),PHI(K)
   10 CONTINUE
      VELOC(1)=8000.
      DENSI(1)=158.
      THICK(1)=0.0
      PHI(1)=0.0
    3 DO 11 I=1,M
   11 RHO(I)=DENSI(I)/32.2
      K=M
      DO 2001 II=1,M
      HI=HI+THICK(K)
      TI=TI+(THICK(K)/VELOC(K))
      VAV=VAV+THICK(K)*VELOC(K)
      WAV=WAV+THICK(K)*DENSI(K)
      IF(HI.LE.100.0) TVAV=VAV
      IF(HI.LE.100.0) TWAV=WAV
 2001 K=K-1
C  COMPUTE THE APPROXIMATE FREQUENCY AND AMPLIFICATION OF EACH LAYER
      APFREQ(1) =  0.0
      APPAMP(1) =  0.0
      DO 15 I  = 2,M
```

```
      APFREQ(I)  = VELOC(I) /(4.0*THICK(I))
   15 APPAMP(I) = DENSI(I-1)/DENSI(I)*VELOC(I-1)/VELOC(I)
      TI=4.0*TI
C       COMPUT DAF AVERAGE AFTER WIGGINS
      R=SQRT((8000.0*158.0)/((TVAV/100.0)*(TWAV/100.0)))
   20 WRITE (6,1006)
 1006 FORMAT (1H0,5HLAYER,2X,9HTHICKNESS,7X,7HDENSITY,6X, 8HVELOCITY,6X,
     17HDAMPING)
      DO 21  K = 1,M
      I  = M+1- K
   21 WRITE (6,1007) I, THICK(I), DENSI(I), VELOC(I), PHI(I)
 1007 FORMAT (I4,F11.1,2F15.1,F15.3)
      DO 5 I=1,M
      PHI(I)=PHI(I)*2.0
    5 CONTINUE
      P = START
      F = 1.0/P
C             START OF MAIN LOOP OF COMPUTATIONS
   70 DO 900 II = 1,IRANGE
      W = 2.0*PI*F
      DO 300 K=1,2
      DO 80  I  = 1,4
      DO 80  J  = 1,4
   80 XP(J,I) = 0.0
      DO 90 I = 1,4
   90 XP(I,I) = 1.0
C   CALCULATION OF REAL AND IMAGINARY PARTS OF PROPAGATION CONSTANT
      GO TO (91,95),K
   91 DO 94 L=1,M
      PCRE(L) = W/VELOC(L)
   94 PCIM(L) = 0.0
      GO TO 100
   95 DO 99 L = 1,M
      PCIM(L) = -PCRE(L)*PHI(L)/2.0
   99 CONTINUE
C                  START OF RECURSION RELATION LOOP
C   CALCULATION OF REAL AND IMAGINARY PARTS OF THE ALPHAS
  100 DO 200 J = 1,N
      ALFCON = (RHO(J)/RHO(J+1))/(PCRE(J) + PCIM(J)*(PCIM(J)/PCRE(J)))
      ALFRE  = ALFCON*(PCRE(J+1) + PCIM(J+1)*(PCIM(J)/PCRE(J)))
      ALFIM  = ALFCON*(PCIM(J+1) - PCRE(J+1)*(PCIM(J)/PCRE(J)))
      ALFREP = 1.0 + ALFRE
      ALFREM = 1.0 - ALFRE
      THETA = PCRE(J+1)*THICK(J+1)
      IF (THETA .GT. THETO) GO TO 200
      SINJ = SIN(THETA)
      COSJ = COS(THETA)
      OMEGA = PCIM(J+1)*THICK(J+1)
  110 EXPOM = 0.5*EXP( OMEGA)
      EXPOP = 0.5*EXP(-OMEGA)
C  CALCULATION OF  XJ  MATRIX
      XJ(1,1) = EXPOM * (ALFREP*COSJ + ALFIM*SINJ)
      XJ(1,2) = EXPOM * (ALFREM*COSJ - ALFIM*SINJ)
      XJ(1,3) = EXPOM * (ALFREP*SINJ - ALFIM*COSJ)
```

```
      XJ(1,4) = EXPOM * (ALFREM*SINJ + ALFIM*COSJ)
      XJ(2,1) = EXPOP * (ALFREM*COSJ + ALFIM*SINJ)
      XJ(2,2) = EXPOP * (ALFREP*COSJ - ALFIM*SINJ)
      XJ(2,3) = -EXPOP *(ALFREM*SINJ - ALFIM*COSJ)
      XJ(2,4) = -EXPOP *(ALFREP*SINJ + ALFIM*COSJ)
      XJ(3,1) = -XJ(1,3)
      XJ(3,2) = -XJ(1,4)
      XJ(3,3) =  XJ(1,1)
      XJ(3,4) =  XJ(1,2)
      XJ(4,1) = -XJ(2,3)
      XJ(4,2) = -XJ(2,4)
      XJ(4,3) =  XJ(2,1)
      XJ(4,4) =  XJ(2,2)
C  CALCULATION OF  XP  MATRIX
      DO 130  J1 = 1,4
      DO 120  J2 = 1,4
      Y(J2) = 0.0
      DO 120  J3 = 1,4
  120 Y(J2) = Y(J2) + XJ(J2,J3)*XP(J3,J1)
      DO 130  J2 = 1,4
  130 XP(J2,J1) = Y(J2)
  200 CONTINUE
C   CALCULATION OF AMPLIFICATION RATIO
      Z(1,1) = XP(2,2) - XP(1,2)
      Z(1,2) = XP(2,4) - XP(1,4)
      Z(1,3) = XP(1,1) - XP(2,1)
      Z(2,1) = XP(4,2) - XP(3,2)
      Z(2,2) = XP(4,4) - XP(3,4)
      Z(2,3) = XP(3,1) - XP(4,1)
      DEN = Z(1,1)*Z(2,2) - Z(1,2)*Z(2,1)
      DRN = Z(1,3)*Z(2,2) - Z(1,2)*Z(2,3)
      DIN = Z(1,1)*Z(2,3) - Z(2,1)*Z(1,3)
      DRO = DRN/DEN
      DIO = DIN/DEN
      CRN = XP(1,1) + XP(1,2)*DRO + XP(1,4)*DIO
      CIN = XP(3,1) + XP(3,2)*DRO + XP(3,4)*DIO
  300 AMPRAT(K) = SQRT(CRN*CRN + CIN*CIN)
      KOUNT=KOUNT+1
      IF(P.LE.1.000000 ) GO TO 3300
      AMPRAT(1)=R
      AMPRAT(2)=R
3300  AMP(KOUNT)=AMPRAT(2)
      P = P + STEP
      F = 1.0/P
  900  CONTINUE
      DO 901 I=1,IRANGE
  901 AMP(I)=AMP(I)*(1.+SIG*.441)
      RETURN
      END
```

@PRT,S EDYN

```
HASSELMAN-T.TPFS.EDYN
      SUBROUTINE EDYN(V1,T1,DE1,DA1,N,ITEST,W)
      REAL V(21),T(21),DE(21),DA(21),W(21),V1(21),T1(21),DE1(21),
     1DA1(21),EOP(21)
C
C      READ DATA IN DECENDING ORDER
C
      DAMP=1.0
      IF(ITEST.NE.1) READ(5,2) DAMP
      DO 1 I=1,N
      READ(5,2) T(I),DE(I),W(I)
    2 FORMAT( )
    1 CONTINUE
C
C     FORM OVERBURDEN PRESSURE WITH DEPTH
C
      SUM=0.0
      DO 4 I=1,N
      IF(W(I).GT.48.5) W(I)=48.5
      W(I)=W(I)/100.
      SUM=SUM+DE(I)*T(I)
      EOP(I)=SUM
    4 CONTINUE
      DO 5 I=1,N
      V(I)=27.9*((EOP(I)/(1.+W(I)))**.411)
    5 CONTINUE
      C1=DAMP*V(1)
      DO 10 I=1,N
   10 DA(I)=C1/V(I)
      V1(1)=8000.
      DE1(1)=158.
      DA1(1)=0.0
      T1(1)=0.0
C
C      CONVERT DATA TO ASCENDING ORDER
C
      M=N+1
      DO 6 I=2,M
      J=N-I+2
      V1(I)=V(J)
      T1(I)=T(J)
      DE1(I)=DE(J)
      DA1(I)=DA(J)
    6 CONTINUE
    7 CONTINUE
      RETURN
      END

@PRT,S  SSTATA
```

HASSELMAN-T*TPF$.SSTATA

```
      SUBROUTINE SSTATA(AMP,SIG)
      REAL AMP(100),V(21),DE(21),T(21),DA(21)
      REAL W(21)
      READ(5,1) IAPRO,N
    1 FORMAT( )
      IF (IAPRO.EQ.1) GO TO 2
      IF(IAPRO.EQ.2) GO TO 10
      DO 3 I=1,N
      READ(5,1) V(I),DE(I)
    3 CONTINUE
      WRITE(6,50)
   50 FORMAT('1',10X,'DATA USED FOR DAF CALCULATIONS',//,15X,'VELOCITY',
     115X,'DENSITY',/)
      DO 51 I=1,N
      WRITE(6,52) V(I),DE(I)
   52 FORMAT(15X,F7.1,15X,F7.1)
   51 CONTINUE
      I1=1
      I2=N
      GO TO 5
C
C     CALCULATE A VELOCITY PROFILE FROM SOIL PROPERTIES
C
    2 CALL EDYN(V,T,DE,DA,N,1,W)
      WRITE(6,40)
   40 FORMAT('1',10X,'DATA USED FOR DAF CALCULATIONS',//,
     115X,'DENSITY',15X,'THICKNESS',15X,'WATER CONTENT',/)
      NN=N+1
      DO 41 I=2,NN
      J=N+2-I
      WRITE(6,42) DE(I),T(I),W(J)
   42 FORMAT(15X,F7.1,15X,F9.1,21X,F7.3)
   41 CONTINUE
      I1=2
      I2=NN
    5 CONTINUE
      SUM1=0.0
      SUM2=0.0
      DO 6 I=I1,I2
      SUM1=SUM1+V(I)
    6 SUM2=SUM2+DE(I)
      SUM1=SUM1/N
      SUM2=SUM2/N
      DAF2=8000.*158./(SUM1*SUM2)
      DAF=SQRT(DAF2)
      GO TO 15
C
C     CALCULATE DAF AFTER THAT RUSSIAN DUDE
C
   10 READ(5,1) ISOIL,H20
      GO TO (31,32,33,34,35,36),ISOIL
   31 A=5.3
      GO TO 16
```

```
   32 A=2.8
      GO TO 16
   33 A=2.5
      GO TO 16
   34 A=2.0
      GO TO 16
   35 A=1.3
      GO TO 16
   36 A=1.0
   16 C1=EXP(-.0037*H20*H20)
      WRITE(6,54) H20,ISOIL
   54 FORMAT('1',15X,'DEPTH TO WATER TABLE = ',F7.2,/,
     1              16X,'SOIL CODE. . . . . . = ',I7)
      DAF=A*(10.**(.301*C1))
   15 DAF=DAF*(1.+SIG*.441)
      DO 7 I=1,100
    7 AMP(I)=DAF
      RETURN
      END


@PRT,S  SSTATB
```

```
HASSELMAN-T.TPFS.SSTATB
      SUBROUTINE SSTATB(AMP,SIG)
      REAL AMP(100)
      READ(5,100) ICODE,ISAT
  100 FORMAT( )
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20),ICODE
    1 A=.011
      GO TO 101
    2 A= 2.5
      GO TO 101
    3 A=1.
      GO TO 101
    4 A=16.
      GO TO 101
    5 A=26.
      GO TO 101
    6 A=35.
      GO TO 101
    7 A=43.
      GO TO 101
    8 A=93.
      GO TO 101
    9 A=152.
      GO TO 101
   10 A=175.
      GO TO 101
   11 A=192.
      GO TO 101
   12 A=220.
      GO TO 101
   13 A=245.
      GO TO 101
   14 A=284.
      GO TO 101
   15 A=335.
      GO TO 101
   16 A=390.
      GO TO 101
   17 A=415.
      GO TO 101
   18 A=440.
      GO TO 101
   19 A=490.
      GO TO 101
   20 A=515.
  101 CONTINUE
      A=A*1000000.
      READ(5,100) H,DEN
      IF(H.GT.200.) GO TO 110
      IF (H.LT.30.) GO TO 111
      GO TO 112
  110 H=200.
      GO TO 112
  111 H=30.
```

```
  112 CONTINUE
      IF(DEN.LT.1) DEN=135.
      X=1./6.
      CO=(H*A)**X
      VS=125.3*CO/3.0
      IF(ISAT.EQ.1) VS=VS*.85
      WRITE(6,30) H,DEN,ICODE
   30 FORMAT('1',10X,'DATA USED FOR DAF CALCULATIONS',/,
     115X,'DEPTH...........= ',F7.1,' FT',/,
     215X,'DENSITY.........= ',F7.1,' PCF',/,
     315X,'GEOLOGIC CODE..= ',I7,//)
      DAF2=8000.*158./(VS*DEN)
      DAF=SQRT(DAF2)
      DAF=DAF*(1.+SIG*.441)
      DO 200 I=1,100
  200 AMP(I)=DAF
      RETURN
      END
```

@PRT,S WIND

HASSELMAN-T*TPF$.WIND

```
      SUBROUTINE WIND(SH,NS,B,MASS,TN,CEC,CIC,QMS,VMH,FC,ISHAPE,ISITE,VF
     1,ITYPE)
      REAL MASS,SH(30),H(30),GUST(30),QMS(30),VMH(30),C(3)
      REAL FC(30),CEC(10),CIC(10)
      INTEGER ANGLE
      MASS=MASS*12000.
      DO 70 I=1,30
      H(I)=0.0
      GUST(I)=0.0
      QMS(I)=0.0
      VMH(I)=0.0
   70 CONTINUE
      B=B/12.
      READ(5,1) BS
    1 FORMAT( )
      FN=1./TN
      H(1)=SH(NS)/12.
      IF(NS.EQ.1) GO TO 9
      DO 19 I=2,NS
   19 H(I)=(SH(NS-I+1)/12.)+H(I-1)
    9 HT=H(NS)
      GO TO (2,3,4),ISITE
    2 ALFA=1./3.
      RK=.025
      ZG=1500.
      GO TO 5
    3 ALFA=1./4.5
      RK=.01
      ZG=1300.
      GO TO 5
    4 ALFA=1./7.
      RK=.005
      ZG=900.
    5 T=3600./VF
      IF(T.LT.30.) GO TO 6
      IF((T.LT.4000.).AND.(T.GE.30.)) GO TO 7
      IF(T.GE.4000.) GO TO 8
    6 F=1.56-0.0618*(ALOG10(T)**2)-0.0733*ALOG10(T)
      GO TO 16
    7 F=1.317+.06*(ALOG10(T/30.)**2)-0.277*ALOG10(T/30.)
      GO TO 16
    8 F=1.0
   16 VMS=(1.63*VF/F)*((30./ZG)**ALFA)
      VM30=VF/F
      W1=4.*B
      W2=4.*HT
      IF(W1.LT.W2) GO TO 20
      W3=W2
      GO TO 41
   20 W3=W1
   41 VH=VMS*1.46667*((HT/30.)**ALFA)/(ALFA+1.0)
      C(1)=3.85*FN*W3/VH
      C(2)=11.5*FN*B/VH
```

```
      C(3)=3.85*FN*HT/VH
      CSQ=1.0
      DO 15 I=1,3
   15 CSQ=CSQ*((1./C(I))-(1.-EXP(-2.*C(I)))/(2.*C(I)**2))
      XN=4000.*FN/VMS
      SP2=(XN**2)*(1.+XN**2)**(-4./3.)
      GO TO (21,22,23),ISITE
   21 SB=1.30-0.035*(ALOG10(HT/10.)**2)-0.205*ALOG10(HT/10.)
      GO TO 29
   22 IF(HT.LT.100.) GO TO 30
      IF(HT.GE.100.) GO TO 31
   30 SB=1.3-0.05*(ALOG10(HT/10.)**2)-.21*ALOG10(HT/10.)
      GO TO 29
   31 SB=1.04-.142*(ALOG10(HT/100.)**2)-.23*ALOG10(HT/100.)
      GO TO 29
   23 IF(HT.LT.100.) GO TO 32
      IF(HT.GE.100.) GO TO 33
   32 SB=1.3-.00746*(ALOG10(HT/10.)**2)-.277*ALOG10(HT/10.)
      GO TO 29
   33 SB=1.02-.161*(ALOG10(HT/100.)**2)-.252*ALOG10(HT/100.)
   29 S=SB/(1.0 + 0.002*B)
      AA=2.0*ALFA + 1.0
      PI=3.14
      IF(KP.GT.1) GO TO 88
      GO TO (86,87),ISHAPE
   86 CALL SHAPEX(CA,CB,ANGLE,ITYPE,0)
      GO TO 88
   87 READ(5,1) CA,CB,ANGLE
   88 DC=CA-CB
      PBAR=0.00256*(VMS**2)*B*(HT**AA)/(AA*(30.**(2.*ALFA)))*DC
      BA=PBAR/(2.*PI*FN*MASS*VH)
      R=((PI*CSQ*SP2)/(4.*(BA+BS)))+S
      R=SQRT(R)
      DO 35 I=1,NS
      TZ=2.35*SQRT(RK)/((H(I)/30.)**ALFA)
      GUST(I) = 1.0 +(5.1)*R*TZ
      VMH(I)=VMS*(H(I)/30.)**ALFA
      QMS(I)=0.00256*GUST(I)*(VMH(I)**2)
   35 CONTINUE
      B=B*12.
      CALL WNDFOR(QMS,SH,NS,B,CA,CB,ANGLE,FC,1)
      CALL INTPRS(QMS,GUST,VMH,CA,CB,CIC,CEC,ANGLE,ITYPE,NS,ISHAPE)
      RETURN
      END


@PRT,S  REG1
```

```
HASSELMAN-T.TPF$.REG1
      SUBROUTINE REG1(ALFA,BETA,DIFF)
      REAL VEL(10),RETRN(10)
      READ(5,2) NPTS
      WRITE(6,20) NPTS
   20 FORMAT('0',11X,'NUMBER OF DATA PTS FOR REGRESSION ANALYSIS',I5,//)
      READ(5,2)(VEL(I),I=1,NPTS)
      READ(5,2)(RETRN(I),I=1,NPTS)
    2 FORMAT( )
      WRITE(6,25) (VEL(I),I=1,NPTS)
   25 FORMAT('0',11X,'WIND VELOCITY (MPH)=',2X,10(F7.2,2X),/)
      WRITE(6,26) (RETRN(I),I=1,NPTS)
   26 FORMAT('0',11X,'RETURN PERIOD (YRS)=',2X,10(F7.2,2X),/)
      DO 3 I=1,NPTS
      RETRN(I)=1./RETRN(I)
    3 CONTINUE
      DO 8 I=1,NPTS
    8 RETRN(I)=ALOG10(RETRN(I))
C
C        DETERMINE THE COEFFICIENTS FOR THE 1ST ORDER LEAST SQUARES FIT
C
      TEMP=0.0
      SUM=0.0
      DO 6 I=1,NPTS
      SUM=VEL(I)+ SUM
    6 TEMP=RETRN(I)+TEMP
      RMEAN=TEMP/FLOAT(NPTS)
      VMEAN=SUM/FLOAT(NPTS)
      DIFF=0.0
      DIF=0.0
      DO 7 I=1,NPTS
      DIFF=DIFF+(VEL(I)-VMEAN)**2
      DIF=DIF+(VEL(I)-VMEAN)*RETRN(I)
    7 CONTINUE
      BETA=DIF/DIFF
      ALFA=RMEAN-BETA*VMEAN
      DIFF=0.0
      DO 9 I=1,NPTS
      A=RETRN(I)-BETA*VEL(I)
      DIFF=DIFF+(A-ALFA)**2
    9 CONTINUE
      DIFF = SQRT(DIFF/FLOAT(NPTS-1))
      RETURN
      END

@PRT,S  SHAPEX
```

```
HASSELMAN-T*TPFS.SHAPEX
      SUBROUTINE SHAPEX(CA,CB,ANGLE,ITYPE,ICON)
      INTEGER ANGLE
      IF(ICON.NE.0) GO TO 500
      READ(5,501) ITYPE,ANGLE
  501 FORMAT( )
      WRITE(6,400)ITYPE,ANGLE
  400 FORMAT('0',11X,'BUILDING SHAPE CODE = ',I5,5X,'WIND DIRECTION CODE
     1 = ',I5,/)
  500 CONTINUE
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23
     *,24,25),ITYPE
    1 GO TO (66,67,68),ANGLE
   66 CA=0.9
      CB=-0.3
      GO TO 200
   67 CA=0.5
      CB=-0.4
      GO TO 200
   68 CA=-0.4
      CB=CA
      GO TO 200
    2 GO TO (69,70,71),ANGLE
   69 CA=0.9
      CB=-0.5
      GO TO 200
   70 CA=0.5
      CB=-CA
      GO TO 200
   71 CA=-0.6
      CB=CA
      GO TO 200
    3 GO TO (72,70,73),ANGLE
   72 CA=0.9
      CB=-0.6
      GO TO 200
   73 CA=-0.7
      CB=CA
      GO TO 200
    4 GO TO (74,70,75),ANGLE
   74 CA=0.8
      CB=-0.5
      GO TO 200
   75 CA=-0.3
      CB=CA
      GO TO 200
    5 GO TO (69,76,77),ANGLE
   76 CA=0.6
      CB=-0.5
      GO TO 200
   77 CA=-0.5
      CB=CA
      GO TO 200
    6 GO TO (69,76,77),ANGLE
```

```
    7 GO TO (69,76,77),ANGLE
    8 GO TO (69,76,71),ANGLE
    9 GO TO (69,78,79),ANGLE
   78 CA=0.5
      CB=-0.6
      GO TO 200
   79 CA=-0.4
      CB=-0.3
      GO TO 200
   10 GO TO (69,80,68),ANGLE
   80 CA=0.5
      CB=-0.8
      GO TO 200
   11 GO TO (66,67,68),ANGLE
   12 GO TO (69,70,77),ANGLE
   13 GO TO (74,81,68),ANGLE
   81 CA=0.4
      CB=-0.5
      GO TO 200
   14 GO TO (66,90,77),ANGLE
   15 GO TO (82,81,73),ANGLE
   82 CA=.9
      CB=-.4
      GO TO 200
   16 GO TO (82,91,73),ANGLE
   17 GO TO (82,91,84),ANGLE
   84 CA=-.8
      CB=CA
      GO TO 200
   18 GO TO (82,91,84),ANGLE
   19 GO TO (85,91,71),ANGLE
   85 CA=+.9
      CB=-.2
      GO TO 200
   20 GO TO (66,81,71),ANGLE
   21 GO TO (66,86,71),ANGLE
   86 CA=.5
      CB=-.3
      GO TO 200
   22 GO TO (82,87,71),ANGLE
   87 CA=.5
      CB=-.4
      GO TO 200
   23 GO TO (88,81,73),ANGLE
   88 CA=.8
      CB=-.3
      GO TO 200
   24 GO TO (89,201,73),ANGLE
   89 CA=.8
      CB=-.6
      GO TO 200
   90 CA=0.4
      CB=-0.3
      GO TO 200
```

```
   91 CA=0.4
      CB=-CA
      GO TO 200
   25 GO TO (74,202,73),ANGLE
  201 WRITE(6,300)
  300 FORMAT('1   THERE IS NO A.N.S.I. CODE SPECIFICATION FOR A WIND DIR
     *ECTION EQUAL TO 45 DEGREES',/,'    ANALYSIS WILL THEREFORE BE BASE
     *D ON THE ASSUMPTION OF A ZERO (0) WIND ANGLE',///)
      ANGLE=1
      GO TO 89
  202 WRITE(6,300)
      ANGLE=1
      GO TO 74
  200 CONTINUE
      RETURN
      END

@PRT,S  WNDFOR
```

```
HASSELMAN-T*TPF$.WNDFOR
      SUBROUTINE WNDFOR(QMS,SH,NS,B,CA,CB,ANGLE,FC,IFL)
      REAL FC(30),QMS(30),SH(30)
      INTEGER ANGLE
      DO 1 I=1,NS
    1 FC(I)=QMS(I)
      DO 3 I=1,NS
      IJ=NS-I+1
    3 QMS(I)=FC(IJ)
      DO 4 I=1,30
      FC(I)=0.0
    4 CONTINUE
      FC(1)=B*SH(1)*(3.*QMS(1)+QMS(2))/8.
      DO 60 I=2,NS
      FC(I)=(3.*(SH(I)+SH(I-1))*QMS(I)+QMS(I-1)*SH(I-1)+QMS(I+1)*SH(I))*
     1B/8.
   60 CONTINUE
      SF=CA-CB
      DO 61 I=1,NS
   61 FC(I)=(CA-CB)*FC(I)/14400.
      IF(IFL.EQ.0) RETURN
      WRITE(6,70) CA,CB,SF
   70 FORMAT('1',9X,'EXTERNAL PRESSURE COEFFICIENT FOR WALL 1 . . .=',F8
     *      .3,/,10X,'EXTERNAL PRESSURE COEFFICIENT FOR WALL 2 . . .=',F
     *      8.3,/,10X,'SHAPE FACTOR FOR WIND DIRECTION . . .=',F8.3,/)
      GO TO (50,51,52),ANGLE
   50 ANGL= 0.0
      GO TO 55
   51 ANGL=45.0
      GO TO 55
   52 ANGL=90.0
   55 CONTINUE
      WRITE(6,71) ANGL
   71 FORMAT(10X,'WIND DIRECTION WITH RESPECT TO',/,
     *        10X,'NORMAL OF WALL 1 . . . . . . . . . . . . . =',,F6.1,' DE
     *GREES',//)
      RETURN
      END

@PRT.S  INTPRS
```

```
HASSELMAN-T*TPFS.INTPRS
          SUBROUTINE INTPRS(Q,G,V,CA,CB,CIC,CEC,ANG,ITYPE,NS,ISHAPE)
          REAL Q(30),G(30),V(30),CIC(10),CEC(10)
          INTEGER ANG
C
C         INVERT THE ORDERING OF THE GUST FACTOR ARRAY
C
          IF(ISHAPE.EQ.1) GO TO 15
          READ(5,16) CC,CD
       16 FORMAT( )
          WRITE(6,501) CC,CD
      501 FORMAT('0',11X,'USER INPUT - PRESSURE COEFFICIENTS = ',2X,2(F8.2,3
         2X),//)
       15 DO 1 I=1,NS
        1 V(I)=G(I)
          DO 2 I=1,NS
          J=NS-I+1
        2 G(I)=V(J)
C
C         COMPUT THE APPROACH PRESSURE WITHOUT GUST FACTOR
C         FOR INTERNAL PRESSURE CALCULATIONS
C
          DO 3 I=1,NS
        3 V(I)=Q(I)/G(I)
C
C         PRESSURE COEFFICIENT FOR BUILDING CORNERS PER ANSI A58.1-1972
C
          CK=-2.0
C
C         DETERMINE INTERNAL PRESSURE COEFFICIENT PER ANSI A58.1-1972
C
          READ(5,16) RATIO,IWALL
          WRITE(6,500) RATIO,IWALL
      500 FORMAT('0',11X,'OPEN AREA RATIO = ',F8.3,5X,'WALL CODE = ',I5,/)
          IF(RATIO.GT.0.3) GO TO 71
C
C         IWALL =1,4 CORRESPONDS TO THE  WALL NUMBERING CONVENTION
C         IWALL = 5 IS THE CODE FOR A UNIFORM DISTRIBUTION OF WINDOWS
C
          GO TO (62,63,64,65,41),IWALL
       62 GO TO (40,41,42),ANG
       63 GO TO (42,42,42),ANG
       64 GO TO (42,41,40),ANG
       65 GO TO (42,42,42),ANG
       40 CI=0.3 + (RATIO*5.)/3.
          GO TO 80
       41 CI=0.3
          GO TO 80
       42 CI=-0.3-RATIO
          GO TO 80
       71 GO TO (51,52,53,54,41),IWALL
       51 GO TO (43,44,45),ANG
       52 GO TO (45,45,45),ANG
       53 GO TO (45,44,43),ANG
```

```
   54 GO TO (45,45,45),ANG
   43 CI=0.8
      GO TO 80
   44 CI=0.4
      GO TO 80
   45 CI=-0.6
   80 CONTINUE
      IF(ISHAPE.EQ.2) GO TO 50
C
C     DETERMINE THE EXTERNAL PRESSUR COEFFICIENTS OF SIDE
C     WALLS PARALLEL TO GET LINE OF FRAME ACTION
C
      IF(ITYPE.LE.3) GO TO 10
      IF(ITYPE.GT.3.AND.ITYPE.LE.13) GO TO 11
      IF(ITYPE.GT.13.AND.ITYPE.LE.23) GO TO 12
      IF(ITYPE.EQ.24.OR.ITYPE.EQ.25) GO TO 13
   10 GO TO (20,21,22),ANG
   20 ANG=3
      GO TO 21
   22 ANG=1
      GO TO 21
   11 ITYPE=ITYPE+10
      GO TO (20,21,22),ANG
   12 ITYPE=ITYPE-10
      GO TO (20,21,22),ANG
   13 GO TO (23,23,24),ANG
   23 ANG=3
      GO TO 21
   24 ANG=1
   21 CALL SHAPEX(CC,CD,ANG,ITYPE,1)
   50 CONTINUE
C
C     DO A FREE BODY ANALYSIS OF EACH WALL FOR MAXIMUM WINDOW PRESSURE
C
      CEC(1)=CA
      CEC(2)=CB
      CEC(3)=CC
      CEC(4)=CD
      CEC(5)=CK
      DO 67 I=1,5
   67 CIC(I)=CI
      IF(IWALL.NE.5) GO TO 66
      C1=CA-CI
      C2=CB-CI
      C3=CC-CI
      C4=CD-CI
      C5=CK-CI
      IF(ABS(C1).GE.ABS(CA)) GO TO 90
      CIC(1)=-CI
   90 IF(ABS(C2).GE.ABS(CB)) GO TO 91
      CIC(2)=-CI
   91 IF(ABS(C3).GE.ABS(CC)) GO TO 92
      CIC(3)=-CI
   92 IF(ABS(C4).GE.ABS(CD)) GO TO 93
```

```
      CIC(4)=-CI
   93 IF(ABS(C5).GE.ABS(CK)) GO TO 66
      CIC(5)=-CI
   66 CONTINUE
C
C     AT THIS POINT ALL DATA IS READY FOR WINDOW PRESSURE CALCULATIONS
C
  900 FORMAT(1P10E10.2)
      RETURN
      END
```

```
@PRT,S  TRNADO
```

```
HASSELMAN-T*TPFS.TRNADO
      SUBROUTINE TRNADO(VT,SH,NS,FC,B,CE,CI,QMS,V)
      REAL CE(10),CI(10),V(30)
      REAL QMS(30),SH(30),FC(30)
C
C     CALCULATE A UNIFORM PRESSURE DISTRIBUTION - NO GUSTING
C     NO VARIATION WITH HEIGHT - ASSUME DIRECT HIT BY TORNADO
C
      DO 2 J=1,5
      CE(J)=1.0
    2 CI(J)=0.0
      DO 1 I=1,NS
      V(I)=0.0
    1 QMS(I)=0.00256*(VT**2)
      CALL WNDFOR(QMS,SH,NS,B,.9,-.3,1,FC,0)
   54 CONTINUE
      RETURN
      END
```

```
@PRT,S  PRSFLC
```

```
HASSELMAN-T*TPFS.PRSPEC
      SUBROUTINE PRSPEC(BASE,SIG)
      REAL BASE(100),PER(100)
      PER(1)=0.1
      DO 1 I=2,100
    1 PER(I)=PER(I-1)+0.1
      WRITE(6,100) SIG
  100 FORMAT('1',15X,'BASE SPECTRUM IN TERMS OF THE MEAN AND ',
     *F5.2,' STANDARD DEVIATIONS',///)
      DO 200 I=1,10
      J=10*(I-1)
      WRITE(6,101)(PER(J+K),K=1,10)
  101 FORMAT(10X,'PERIOD (SEC)',10(2X,F7.2))
      WRITE(6,102)(BASE(J+K),K=1,10)
  102 FORMAT(10X,'PSV (IN/SEC)',10(2X,F7.2),//)
  200 CONTINUE
      RETURN
      END
```

```
HASSELMAN-T*TPF$.LSROOF
      SUBROUTINE LSROOF(ITYPE,L,W,H,P1,PI,IFLY,IW)
      INTEGER TYPEA
      REAL L,LPR,LCP,TAB(9),VECTOR(15)
      READ(5,112) TYPEA,ALPHA,VL,CL,DOP,NP
  112 FORMAT( )
      WRITE(6,305)
      IF(TYPEA.EQ.3) READ(5,112) (VECTOR(I),I=1,NP)
      IF(TYPEA.EQ.3) WRITE(6,319) (VECTOR(I),I=1,NP)
  319 FORMAT('0',10X,'ROOF PRESSURE COEFFICIENTS - USER INPUT = ',/,15X,
     110(5X,F8.2),/,)
  305 FORMAT('1',15X,'L O N G   S P A N   R O O F   A N A L Y S I S',//)
  306 FORMAT('0',10X,'ANALYSIS CODE . . . . .=',I5,/,
     1           11X,'SLOPE OF ROOF . . . . .=',F8.2,' DEGREES',/,
     2           11X,'ROOF UPLIFT CAPACITY   =',1PE11.3,' POUNDS',/,
     3           11X,'COLLAPSE CAPACITY . . .=',1PE11.3,' POUNDS',/,
     4           11X,'DEPTH OF PONDING  . . .=',0PF8.2,' FEET',/,
     5           11X,'ROOF UPLIFT LOAD.  .  .=',1PE11.3,' POUNDS',/,
     6           11X,'PONDING LOAD. . .  .  .=',1PE11.3,' POUNDS',//)
      L=L/12.
      RL=0.0
      W=W/12.
      H=H/12.
      PI=-PI
      IF(ALPHA.GE.85.0) WRITE(6,111)
  111 FORMAT(//,5X,'*****   SLOPE OF ROOF WAS TOO GREAT FOR ANALYSIS, AN
     1GLE HAS BEEN RESET TO 85 DEGREES   *****')
      IF(ALPHA.GE.85.0) ALPHA=84.9
      IF(TYPEA.EQ.3) GO TO 1000
      FACT1=L/W
      FACT2=W/H
      FACT3=H/W
      IF(FACT1.LT.0.4.OR.FACT1.GT.2.5) GO TO 500
      IF(FACT2.LT.0.67.OR.FACT2.GT.1.5) GO TO 500
      IF(TYPEA.EQ.2) GO TO 500
C   GENERAL SWISS ANALYSIS FOR ROOF STABILITY
      IF(ALPHA.GE.0.0.AND.ALPHA.LT.20.0) WCP=-1.0
      IF(ALPHA.GE.20.0.AND.ALPHA.LT.50.0) WCP=0.01*(5.*ALPHA-200.)
      IF(ALPHA.GE.50.0.AND.ALPHA.LE.85.0) WCP=ALPHA*0.01
      LCP=-0.7
      WPR=WCP*PI
      LPR=LCP*PI
      AREA=W/2.*L
      VF=(WPR*AREA)+2.*(PI*AREA)+(LPR*AREA)
C   CHECK FOR STABILITY OF ROOF
      IF((VF+VL).GE.0.) GO TO 75
      IFLY=1
      GO TO 1500
   75 IFLY=0
      GO TO 1500
  500 CONTINUE
C   GENERAL ANSI ANALYSIS FOR ROOF STABILITY
      IF(FACT3.LE.0.) GO TO 19
      IF(FACT3.GE.0.001.AND.FACT3.LT.0.3) GO TO 20
```

```
      IF(FACT3.GE.0.3.AND.FACT3.LT.0.5) GO TO 21
      IF(FACT3.GE.0.5.AND.FACT3.LT.1.5) GO TO 22
      IF(FACT3.GE.1.5) GO TO 23
   19 WCP=-1.0
      GO TO 35
   20 TAB(1)=0.01*ALPHA
      TAB(2)=0.20
      TAB(3)=0.25
      TAB(4)=0.30
      TAB(5)=0.35
      TAB(6)=0.40
      TAB(7)=0.45
      TAB(8)=0.50
      TAB(9)=0.01*ALPHA
      GO TO 40
   21 TAB(1)=-1.0
      TAB(2)=-0.75
      TAB(3)=-0.50
      TAB(4)=-0.20
      TAB(5)=0.05
      TAB(6)=0.30
      TAB(7)=0.45
      TAB(8)=0.50
      TAB(9)=0.01*ALPHA
      GO TO 40
   22 TAB(1)=-1.0
      TAB(2)=-1.0
      TAB(3)=-0.80
      TAB(4)=-0.55
      TAB(5)=-0.30
      TAB(6)=-0.05
      TAB(7)=0.20
      TAB(8)=0.45
      TAB(9)=0.01*ALPHA
      GO TO 40
   23 TAB(1)=-1.0
      TAB(2)=-1.0
      TAB(3)=-1.0
      TAB(4)=-0.90
      TAB(5)=-0.60
      TAB(6)=-0.35
      TAB(7)=-0.10
      TAB(8)=0.20
      TAB(9)=0.01*ALPHA
   40 IF(ALPHA.GE.(0.0).AND.ALPHA.LT.(10.)) GO TO 95
      IF(ALPHA.GE.(50.).AND.ALPHA.LT.(85.)) GO TO 96
      DO 1 I=1,8
    1 IF(ALPHA.GE.(10.+(I-1)*5.).AND.ALPHA.LT.(10.+(I*5.))) GO TO 99
   95 WCP=-1.0
      GO TO 35
   96 WCP=TAB(9)
      GO TO 35
   99 WCP=TAB(I+1)
   35 LCP=-0.7
```

```
      IF(ALPHA.LT.10.0) LCP=-1.0
      WPR=WCP*PI
      LPR=LCP*PI
      AREA=W/2.*L
      VF=(WPR*AREA)+2.*(PI*AREA)+(LPR*AREA)
C   CHECK FOR STABILITY OF THE ROOF
      IF((VF+VL).GE.0.) GO TO 65
      IFLY=1
      GO TO 1500
   65 IFLY=0
      GO TO 1500
 1000 CONTINUE
C   DETAILED SWISS ANALYSIS
      DO 2 J=1,9
      IF(ITYPE.NE.J) GO TO 2
      GO TO 201
    2 CONTINUE
      DO 910 J=14,19
      IF(ITYPE.NE.J) GO TO 910
      GO TO 201
  910 CONTINUE
      IF(ITYPE.EQ.10.OR.ITYPE.EQ.20) GO TO 203
      IF(ITYPE.EQ.11.OR.ITYPE.EQ.21) GO TO 204
      IF(ITYPE.EQ.12.OR.ITYPE.EQ.22) GO TO 205
      IF(ITYPE.EQ.13.OR.ITYPE.EQ.23) GO TO 206
      IF(ITYPE.EQ.24) GO TO 201
      IF(ITYPE.EQ.25) GO TO 201
  201 CONTINUE
C   STANDARD SYMMETRIC BUILDINGS
      AREA=(W/2.)*(L/2.)
      VF=PI*AREA*(VECTOR(1)+VECTOR(2)+VECTOR(3)+VECTOR(4))+AREA*4.*PI
      IF((VF+VL).GE.0.) GO TO 55
      IFLY=1
      GO TO 1500
   55 IFLY=0
      GO TO 1500
  203 CONTINUE
C   PEAKED ROOF BUILDING
      C1=COS(60.*3.1416/180.)
      C2=COS(30.*3.1416/180.)
      X1=W*(C1**2)
      X2=W*(C2**2)
      A1=X1*L/2.
      A2=X2*L/2.
      VF=PI*A1*(VECTOR(1)+VECTOR(2))+PI*A2*(VECTOR(3)+VECTOR(4))
     1 +(A1+A2)*PI*2.
      IF((VF+VL).GE.0.) GO TO 54
      IFLY=1
      GO TO 1500
   54 IFLY=0
      GO TO 1500
  204 CONTINUE
C   SAW-TOOTHED BUILDING
      C1=COS(60.*3.1416/180.)
```

```
      C2=COS(30.*3.1416/180.)
      X1=W/4.*(C1**2)
      X2=W/4.*(C2**2)
      A1=X1*L
      A2=X2*L
      VF=PI*A1*(VECTOR(1)+VECTOR(3)+VECTOR(5)+VECTOR(7))
     1 +PI*A2*(VECTOR(2)+VECTOR(4)+VECTOR(6)+VECTOR(8))
     2+PI*L*W
      IF((VF+VL).GE.0.) GO TO 53
      IFLY=1
      GO TO 1500
   53 IFLY=0
      GO TO 1500
  205 CONTINUE
C   FLAT-ROOFED BUILDINGS
      C1=(30.*3.1416/180.)
      A1=((W-2*.7*H*COS(C1))+W)*0.5*.7*H*COS(C1)
      A2=((L-2.*.7*H*COS(C1))+L)*0.5*.7*H*COS(C1)
      A3=(L*W-(A1+A2)*2.)/4.
      VF=PI*A1*(VECTOR(7)+VECTOR(8))+PI*A2*(VECTOR(5)+VECTOR(6))
     1 +PI*A3*(VECTOR(1)+VECTOR(2)+VECTOR(3)+VECTOR(4))+PI*L*W
      IF((VF+VL).GE.0.) GO TO 52
      IFLY=1
      GO TO 1500
   52 IFLY=0
      GO TO 1500
  206 CONTINUE
C   ROOF-VENTED BUILDINGS
      X1=(W-H)/2.
      X2=H/2.
      A1=L*X1
      A2=X2*(0.6*L)
      VF=PI*A1*(VECTOR(1)+VECTOR(6))+PI*A2*(VECTOR(3)+VECTOR(4))
     * +PI*2.*A1
      IF((VF+VL).GE.0.) GO TO 51
      IFLY=1
      GO TO 1500
   51 IFLY=0
 1500 IF(CL.LE.0.) GO TO 81
C  COLLAPSE ANALYSIS DUE TO PONDING
      PAREA=L*W
      RL=PAREA*62.40*DOP
      IF(RL.LT.CL) GO TO 81
      IW=1
      GO TO 800
   81 IW=0
  800 CONTINUE
      WRITE(6,306) TYPEA,ALPHA,VL,CL,DOP,VF,RL
      L=L*12.
      W=W*12.
      H=H*12.
      RETURN
      END

@PRT,S  WNDLOD
```

```
HASSELMAN-T*TPFS.WNDLOD
      SUBROUTINE WNDLOD(ISITE,ISHAPE,VF)
      READ(5,1) ISITE,ITEST,ITY,ISHAPE
      WRITE(6,20)
   20 FORMAT('1',10X,'W I N D  L O A D  A N A L Y S I S',//)
      WRITE(6,10)ISITE,ITEST,ITY,ISHAPE
   10 FORMAT('0',10X,'ISITE= ',I5,5X,'ITEST= ',I5,5X,'ITY= ',I5,5X,'ISHA
     1PE= ',I5,//)
      SIG=0.0
      IF(ITEST.EQ.1) READ(5,1) SIG
      IF(ITEST.EQ.1) WRITE(6,50) SIG
   50 FORMAT('0',10X,'ANALYSIS TO BE BASED ON A MEAN WIND VELOCITY AND '
     1,F5.1,' SIGMA',//)
    1 FORMAT( )
      GO TO(71,78),ITEST
   71 CALL REG1(A1,B1,DIFF)
      GO TO (73,74),ITY
   73 READ(5,1) PERIOD
      WRITE(6,11) PERIOD
   11 FORMAT('/',11X,'RETURN PERIOD IN YRS = ',F10.2,//)
      XX=1./PERIOD
      GO TO 75
   74 READ(5,1) BLIFE,PROB
      WRITE(6,21) BLIFE,PROB
   21 FORMAT('0',11X,'LIFE OF BUILDING IN YRS = ',F8.2,5X,'PROBABILITY O
     1F NON OCCURRENCE = ',F8.3,//)
      XX=ALOG(1./PROB)/BLIFE
   75 VF = (ALOG10(XX)-A1*(1.+SIG*DIFF))/B1
      WRITE(6,51) VF
   51 FORMAT('0',10X,'FASTEST MILE WIND VELOCITY AT 30 FT - FREE FIELD',
     1          /,11X,' (NO GUST) FOR THE STATISTICAL PARAMETERS CHOSE
     2N = ',F8.2,' MPH',//)
      GO TO 72
   78 READ(5,1) VF
      WRITE(6,13) VF
   13 FORMAT('0',11X,'USERS VALUE OF WIND VELOCITY -FASTEST MILE AT 30 F
     1T ABOVE GROUND - FREE FIELD IN MPH =',F10.2,//)
   72 CONTINUE
      RETURN
      END


@PRT,S  SOILOD
```

HASSELMAN-T*NBS.SOILOD

```
      SUBROUTINE SOILOD(AR,VR,DR,Y,T)
      REAL AMP(100),Y(100),HR(100),T(100),TIN(100),YIN(100)
      DO 110 I=1,100
      Y(I)=0.0
      HR(I)=0.0
      T(I)=0.0
      AMP(I)=0.0
  110 CONTINUE
      READ(5,20) IPROC,SIG
   20 FORMAT( )
      GO TO (1,1,2,3,4),IPROC
    1 CALL SDYN(AMP,SIG)
      GO TO 5
    2 CALL SSTATA(AMP,SIG)
      GO TO 5
    3 CALL SSTATB(AMP,SIG)
      GO TO 5
    4 READ(5,20) NDATA
      READ(5,20) (TIN(I),I=1,NDATA)
      READ(5,20) (YIN(I),I=1,NDATA)
      GO TO 6
    5 CONTINUE
      PI=2.*3.1415926
      TA=PI*VR/(AR*386.)
      TD=PI*DR/VR
    6 CONTINUE
C
C     FORM PERIOD ARRAY
C
      DO 10 I=1,100
   10 T(I)=0.1*I
      IF(IPROC.EQ.5) GO TO 15
C
C     FORM HARD ROCK SPECTRUM
C
      DO 11 I=1,100
      IF(T(I).LT.TA) HR(I)=(T(I)*AR*386./PI)
      IF (T(I).GE.TA.AND.T(I).LT.TD) HR(I)=VR
      IF (T(I).GE.TD) HR(I)=DR*PI/T(I)
   11 CONTINUE
C
C     FORM BASE SPECTRUM
C
      DO 12 I=1,100
```

```
   12 Y(I)=HR(I)*AMP(I)
      GO TO 40
   15 CONTINUE
      DY=YIN(2)-YIN(1)
      DX=TIN(2)-TIN(1)
      SL=DY/DX
      TI=T(1)
      YI=YIN(1)=SL*(TIN(1)-TI)
      Y(1)=YI
      K=I
      TX=TIN(K)
      YX=YIN(K)
      DO 30 I=2,100
      IF(T(I).GT.TX) GO TO 35
      Y(I)=YI+SL*(T(I)-TI)
      GO TO 30
   35 CONTINUE
      IF(K.GE.NDATA) GO TO 34
      K=K+1
      TI=TX
      YI=YX
      TX=TIN(K)
      YX=YIN(K)
      SL=(YX-YI)/(TX-TI)
   34 Y(I)=YI+SL*(T(I)-TI)
   30 CONTINUE
   40 CONTINUE
      CALL PRSPEC(Y,SIG)
      RETURN
      END
```

APPENDIX G

UNITED STATES SEISMICITY TABLES

This appendix contains tables of seismicity for the United States, according to geographical location. Three geographical areas are represented: the continental United States, Alaska and Hawaii. Each of the areas has been subdivided into grid "squares," one-half degree on a side as shown in figures 3.15 through 3.17. Seismicity, A, is herein defined by the relationship

$$\log_{10} N = A - bM$$

for a specified area surrounding a site, where N is the frequency of occurrence (events per year) of earthquakes reported in the area having Richter magnitudes greater than or equal to M, and b is a distribution constant set equal to 0.9. The seismicity of a site is treated as a random variable as discussed in section 3.4. Its statistical parameters including a mean value $\overline{A}$ and a standard deviation σ_A have been computed from past earthquake data. The data include the date, location, and magnitude of events having $M \geq 3.5$. The data were used to construct log N versus M histograms for each site (grid area), which take into account all of the recorded earthquakes close enough to cause potential damage, see figure 3.18. A regression analysis was performed for each grid area to determine values of $\overline{A}$ and σ_A.

The tables which follow contain ten columns of data. The first two columns define the longitude sector of the grid area while the second two columns define the latitude sector. Knowing the geographical coordinates of a particular site, one may go through the table until the appropriate longitude is found and then read down the latitude columns to find the appropriate latitude sector.

Two sets of data appear for each grid area, each containing three columns. These are defined as follows:

A(H) = Mean seismicity $\bar{A}$ based on "Historic" data which includes all recorded data up to the year 1961.

O(H) = Standard deviation σ_A based on Historic data.

R(H) = Effective hypocentral distance to the source of a representative earthquake (defined in the following paragraph) of magnitude M, where M is obtained from the above equation, given N. The inverse of N (i.e., 1/N) may be interpreted as an average return period associated with earthquakes of magnitudes $\geq$ M.

The second set of data including A(N), O(N) and R(N) correspond to the same three parameters above except that NOAA data from 1961 to 1973 form the data base in lieu of the "Historic" data prior to 1961. A discussion of how the two groups of data were used is included in section 3.4. In most cases, the data which produce the higher response spectrum are recommended.

These tables are intended to be used in the following way. First determine an Engineering Seismicity (seismicity used for engineering purposes to establish a representative earthquake of magnitude M). This is defined as where n is specified according to the level of confidence desired in bounding A, e.g., zero, one or two-sigma confidence levels. Specify a return period (1/N) or compute N on the basis of risk parameters defined in section 3.4. Next compute the magnitude M of a representative earthquake (M will represent the maximum probable earthquake having a return period of 1/N). Having computed M, read the appropriate value of effective hypocentral distance, R(H) or R(N), from the tables. Then, M and R specify the magnitude and location of the representative earthquake with respect to the site location.

As pointed out by Algermissen [1.4] the development of seismic zoning maps and the characterization of site seismicity is a "relatively recent development in seismological and engineering research." Therefore, the reader should avail himself of the opportunity to read reference [1.4] so as to better understand this area and the position which the maps presented herein hold in this general field of applied research.

SEISMICITY FOR

THE CONTINENTAL UNITED STATES

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
1	66.00 - 66.50	43.00 - 43.50	.000	.000	.00	.000	.000	.00
2	66.00 - 66.50	43.50 - 44.00	3.068	.326	124.46	.000	.000	.00
3	66.00 - 66.50	44.00 - 44.50	3.068	.326	89.00	.000	.000	.00
4	66.00 - 66.50	44.50 - 45.00	3.115	.294	56.17	.000	.000	.00
5	66.00 - 66.50	45.00 - 45.50	3.115	.294	20.09	.000	.000	.00
6	66.00 - 66.50	45.50 - 46.00	3.115	.294	55.02	.000	.000	.00
7	66.00 - 66.50	46.00 - 46.50	3.115	.294	86.06	.000	.000	.00
8	66.00 - 66.50	46.50 - 47.00	3.115	.294	115.59	.000	.000	.00
9	66.00 - 66.50	47.00 - 47.50	2.168	.300	99.92	.000	.000	.00
10	66.00 - 66.50	47.50 - 48.00	2.168	.300	126.23	2.296	.225	103.98
11	66.00 - 66.50	48.00 - 48.50	.000	.000	.00	2.296	.225	69.72
12	66.00 - 66.50	48.50 - 49.00	.000	.000	.00	2.296	.225	35.92
13	66.50 - 67.00	43.00 - 43.50	2.169	.000	142.89	.000	.000	.00
14	66.50 - 67.00	43.50 - 44.00	3.102	.278	117.12	.000	.000	.00
15	66.50 - 67.00	44.00 - 44.50	3.102	.278	83.87	.000	.000	.00
16	66.50 - 67.00	44.50 - 45.00	3.145	.251	54.41	.000	.000	.00
17	66.50 - 67.00	45.00 - 45.50	3.145	.251	34.29	.000	.000	.00
18	66.50 - 67.00	45.50 - 46.00	3.145	.251	54.25	.000	.000	.00
19	66.50 - 67.00	46.00 - 46.50	3.145	.251	85.98	.000	.000	.00
20	66.50 - 67.00	46.50 - 47.00	3.115	.294	116.95	.000	.000	.00
21	66.50 - 67.00	47.00 - 47.50	2.168	.300	118.18	.000	.000	.00
22	66.50 - 67.00	47.50 - 48.00	2.469	.300	149.06	2.296	.225	106.39
23	66.50 - 67.00	48.00 - 48.50	.000	.000	.00	2.296	.225	73.27
24	66.50 - 67.00	48.50 - 49.00	.000	.000	.00	2.296	.225	42.40
25	67.00 - 67.50	43.00 - 43.50	2.406	.061	112.98	.000	.000	.00
26	67.00 - 67.50	43.50 - 44.00	3.157	.233	112.26	.000	.000	.00
27	67.00 - 67.50	44.00 - 44.50	3.190	.216	84.64	.000	.000	.00
28	67.00 - 67.50	44.50 - 45.00	3.219	.204	55.58	.000	.000	.00
29	67.00 - 67.50	45.00 - 45.50	3.219	.204	20.70	.000	.000	.00
30	67.00 - 67.50	45.50 - 46.00	3.219	.204	55.96	.000	.000	.00
31	67.00 - 67.50	46.00 - 46.50	3.190	.216	85.65	.000	.000	.00
32	67.00 - 67.50	46.50 - 47.00	3.167	.250	115.50	.000	.000	.00
33	67.00 - 67.50	47.00 - 47.50	2.469	.300	128.58	.000	.000	.00
34	67.00 - 67.50	47.50 - 48.00	2.818	.252	128.35	2.296	.225	113.32
35	67.00 - 67.50	48.00 - 48.50	2.557	.212	118.52	2.296	.225	83.00

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
36	67.00 - 67.50	48.50 - 49.00	2.557	.212	130.19	2.296	.225	57.61
37	67.50 - 68.00	43.00 - 43.50	2.469	.001	95.45	.000	.000	.00
38	67.50 - 68.00	43.50 - 44.00	3.200	.201	107.39	.000	.000	.00
39	67.50 - 68.00	44.00 - 44.50	3.228	.190	82.36	.000	.000	.00
40	67.50 - 68.00	44.50 - 45.00	3.253	.184	59.71	.000	.000	.00
41	67.50 - 68.00	45.00 - 45.50	3.253	.184	42.75	.000	.000	.00
42	67.50 - 68.00	45.50 - 46.00	3.253	.184	61.39	.000	.000	.00
43	67.50 - 68.00	46.00 - 46.50	3.267	.191	86.87	.000	.000	.00
44	67.50 - 68.00	46.50 - 47.00	3.258	.203	108.57	.000	.000	.00
45	67.50 - 68.00	47.00 - 47.50	2.818	.252	105.48	.000	.000	.00
46	67.50 - 68.00	47.50 - 48.00	3.528	.618	129.95	2.296	.225	124.00
47	67.50 - 68.00	48.00 - 48.50	3.494	.655	132.73	2.296	.225	97.08
48	67.50 - 68.00	48.50 - 49.00	3.494	.655	148.63	2.296	.225	76.52
49	68.00 - 68.50	42.00 - 42.50	2.742	.497	109.36	.000	.000	.00
50	68.00 - 68.50	42.50 - 43.00	2.941	.328	107.13	.000	.000	.00
51	68.00 - 68.50	43.00 - 43.50	2.982	.304	94.36	.000	.000	.00
52	68.00 - 68.50	43.50 - 44.00	3.377	.259	105.91	.000	.000	.00
53	68.00 - 68.50	44.00 - 44.50	3.400	.245	86.23	.000	.000	.00
54	68.00 - 68.50	44.50 - 45.00	3.281	.146	56.44	.000	.000	.00
55	68.00 - 68.50	45.00 - 45.50	3.281	.146	36.57	.000	.000	.00
56	68.00 - 68.50	45.50 - 46.00	3.275	.154	63.65	.000	.000	.00
57	68.00 - 68.50	46.00 - 46.50	3.744	.447	125.86	.000	.000	.00
58	68.00 - 68.50	46.50 - 47.00	3.734	.463	131.82	.000	.000	.00
59	68.00 - 68.50	47.00 - 47.50	3.555	.590	111.34	.000	.000	.00
60	68.00 - 68.50	47.50 - 48.00	3.641	.606	112.73	2.296	.225	137.58
61	68.00 - 68.50	48.00 - 48.50	3.614	.637	118.27	2.296	.225	113.91
62	68.00 - 68.50	48.50 - 49.00	3.614	.637	138.59	2.296	.225	96.98
63	68.50 - 69.00	42.00 - 42.50	3.215	.352	102.97	.000	.000	.00
64	68.50 - 69.00	42.50 - 43.00	3.343	.284	101.18	.000	.000	.00
65	68.50 - 69.00	43.00 - 43.50	3.369	.260	95.69	.000	.000	.00
66	68.50 - 69.00	43.50 - 44.00	3.488	.195	92.70	.000	.000	.00
67	68.50 - 69.00	44.00 - 44.50	3.500	.191	75.59	.000	.000	.00
68	68.50 - 69.00	44.50 - 45.00	3.283	.110	36.68	.000	.000	.00
69	68.50 - 69.00	45.00 - 45.50	3.253	.097	48.78	.000	.000	.00
70	68.50 - 69.00	45.50 - 46.00	3.353	.231	63.07	.000	.000	.00

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
71	68.50 - 69.00	46.00 - 46.50	3.781	.449	109.04	.000	.000	.00
72	68.50 - 69.00	46.50 - 47.00	3.768	.468	114.97	.000	.000	.00
73	68.50 - 69.00	47.00 - 47.50	3.665	.580	95.19	.000	.000	.00
74	68.50 - 69.00	47.50 - 48.00	3.641	.606	84.73	2.296	.225	153.27
75	68.50 - 69.00	48.00 - 48.50	3.614	.637	92.51	2.296	.225	132.44
76	68.50 - 69.00	48.50 - 49.00	3.614	.637	117.46	2.296	.225	118.19
77	69.00 - 69.50	40.00 - 40.50	2.345	.000	134.53	2.746	.503	112.01
78	69.00 - 69.50	40.50 - 41.00	2.470	.000	113.93	2.746	.503	126.96
79	69.00 - 69.50	41.00 - 41.50	3.254	.469	118.33	2.746	.503	148.56
80	69.00 - 69.50	41.50 - 42.00	3.332	.400	100.61	.000	.000	.00
81	69.00 - 69.50	42.00 - 42.50	3.471	.337	93.88	.000	.000	.00
82	69.00 - 69.50	42.50 - 43.00	3.545	.295	86.72	.000	.000	.00
83	69.00 - 69.50	43.00 - 43.50	3.567	.274	86.36	.000	.000	.00
84	69.00 - 69.50	43.50 - 44.00	3.646	.226	87.06	.000	.000	.00
85	69.00 - 69.50	44.00 - 44.50	3.656	.220	57.38	.000	.000	.00
86	69.00 - 69.50	44.50 - 45.00	3.428	.095	59.08	.000	.000	.00
87	69.00 - 69.50	45.00 - 45.50	3.390	.119	47.19	.000	.000	.00
88	69.00 - 69.50	45.50 - 46.00	3.357	.227	41.21	.000	.000	.00
89	69.00 - 69.50	46.00 - 46.50	3.785	.443	72.87	.000	.000	.00
90	69.00 - 69.50	46.50 - 47.00	3.768	.468	100.21	.000	.000	.00
91	69.00 - 69.50	47.00 - 47.50	3.665	.580	72.51	.000	.000	.00
92	69.00 - 69.50	47.50 - 48.00	3.641	.606	55.75	.000	.000	.00
93	69.00 - 69.50	48.00 - 48.50	3.614	.637	68.09	.000	.000	.00
94	69.00 - 69.50	48.50 - 49.00	3.614	.637	99.68	.000	.000	.00
95	69.50 - 70.00	40.00 - 40.50	2.470	.000	125.50	2.746	.503	87.31
96	69.50 - 70.00	40.50 - 41.00	2.567	.000	100.68	2.746	.503	105.80
97	69.50 - 70.00	41.00 - 41.50	3.316	.412	106.53	2.746	.503	130.94
98	69.50 - 70.00	41.50 - 42.00	3.389	.353	84.86	.000	.000	.00
99	69.50 - 70.00	42.00 - 42.50	3.512	.300	72.64	.000	.000	.00
100	69.50 - 70.00	42.50 - 43.00	3.577	.265	59.11	.000	.000	.00
101	69.50 - 70.00	43.00 - 43.50	3.596	.247	67.78	.000	.000	.00
102	69.50 - 70.00	43.50 - 44.00	3.620	.228	70.33	.000	.000	.00
103	69.50 - 70.00	44.00 - 44.50	3.630	.222	57.43	.000	.000	.00
104	69.50 - 70.00	44.50 - 45.00	3.352	.065	53.38	.000	.000	.00
105	69.50 - 70.00	45.00 - 45.50	3.296	.105	36.91	.000	.000	.00

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
106	69.50 - 70.00	45.50 - 46.00	3.274	.268	57.97	.000	.000	.00
107	69.50 - 70.00	46.00 - 46.50	3.738	.485	98.27	.000	.000	.00
108	69.50 - 70.00	46.50 - 47.00	3.716	.517	87.16	.000	.000	.00
109	69.50 - 70.00	47.00 - 47.50	3.665	.580	54.50	.000	.000	.00
110	69.50 - 70.00	47.50 - 48.00	3.641	.606	28.18	.000	.000	.00
111	69.50 - 70.00	48.00 - 48.50	3.614	.637	46.91	.000	.000	.00
112	69.50 - 70.00	48.50 - 49.00	3.614	.637	88.02	.000	.000	.00
113	70.00 - 70.50	40.00 - 40.50	2.470	.000	114.06	2.896	.375	75.43
114	70.00 - 70.50	40.50 - 41.00	2.567	.000	86.52	2.746	.503	87.61
115	70.00 - 70.50	41.00 - 41.50	3.316	.412	91.62	2.746	.503	116.73
116	70.00 - 70.50	41.50 - 42.00	3.389	.353	66.57	.000	.000	.00
117	70.00 - 70.50	42.00 - 42.50	3.512	.300	55.45	.000	.000	.00
118	70.00 - 70.50	42.50 - 43.00	3.577	.265	28.46	.000	.000	.00
119	70.00 - 70.50	43.00 - 43.50	3.599	.244	51.43	.000	.000	.00
120	70.00 - 70.50	43.50 - 44.00	3.623	.225	51.68	.000	.000	.00
121	70.00 - 70.50	44.00 - 44.50	3.634	.218	47.91	.000	.000	.00
122	70.00 - 70.50	44.50 - 45.00	3.358	.057	42.92	.000	.000	.00
123	70.00 - 70.50	45.00 - 45.50	3.303	.095	54.81	.000	.000	.00
124	70.00 - 70.50	45.50 - 46.00	3.279	.264	70.41	.000	.000	.00
125	70.00 - 70.50	46.00 - 46.50	3.742	.479	109.02	.000	.000	.00
126	70.00 - 70.50	46.50 - 47.00	3.716	.517	82.27	.000	.000	.00
127	70.00 - 70.50	47.00 - 47.50	3.665	.580	44.34	.000	.000	.00
128	70.00 - 70.50	47.50 - 48.00	3.693	.621	15.97	.000	.000	.00
129	70.00 - 70.50	48.00 - 48.50	3.667	.651	48.90	.000	.000	.00
130	70.00 - 70.50	48.50 - 49.00	3.614	.637	85.10	.000	.000	.00
131	70.50 - 71.00	40.00 - 40.50	2.970	.310	117.01	2.894	.375	53.47
132	70.50 - 71.00	40.50 - 41.00	2.982	.304	89.72	2.746	.503	74.60
133	70.50 - 71.00	41.00 - 41.50	3.460	.396	87.34	2.746	.503	107.31
134	70.50 - 71.00	41.50 - 42.00	3.513	.352	47.20	.000	.000	.00
135	70.50 - 71.00	42.00 - 42.50	3.609	.313	48.52	.000	.000	.00
136	70.50 - 71.00	42.50 - 43.00	3.663	.284	29.22	.000	.000	.00
137	70.50 - 71.00	43.00 - 43.50	3.679	.268	39.68	.000	.000	.00
138	70.50 - 71.00	43.50 - 44.00	3.609	.237	40.93	.000	.000	.00
139	70.50 - 71.00	44.00 - 44.50	3.620	.228	43.69	.000	.000	.00
140	70.50 - 71.00	44.50 - 45.00	3.335	.049	41.63	.000	.000	.00

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
141	70.50 - 71.00	45.00 - 45.50	3.381	.228	53.61	.000	.000	.00
142	70.50 - 71.00	45.50 - 46.00	3.410	.367	91.80	.000	.000	.00
143	70.50 - 71.00	46.00 - 46.50	3.777	.510	117.25	.000	.000	.00
144	70.50 - 71.00	46.50 - 47.00	3.749	.551	84.48	.000	.000	.00
145	70.50 - 71.00	47.00 - 47.50	3.715	.597	36.60	.000	.000	.00
146	70.50 - 71.00	47.50 - 48.00	3.693	.621	31.83	.000	.000	.00
147	70.50 - 71.00	48.00 - 48.50	3.667	.651	57.27	.000	.000	.00
148	70.50 - 71.00	48.50 - 49.00	3.614	.637	90.20	.000	.000	.00
149	71.00 - 71.50	39.00 - 39.50	3.775	.232	220.42	3.368	.419	75.77
150	71.00 - 71.50	39.50 - 40.00	3.841	.203	201.95	3.365	.419	24.41
151	71.00 - 71.50	40.00 - 40.50	2.992	.300	103.43	2.896	.375	43.26
152	71.00 - 71.50	40.50 - 41.00	3.002	.298	78.58	2.746	.503	69.72
153	71.00 - 71.50	41.00 - 41.50	3.472	.386	82.40	2.746	.503	103.98
154	71.00 - 71.50	41.50 - 42.00	3.522	.346	52.48	.000	.000	.00
155	71.00 - 71.50	42.00 - 42.50	3.620	.302	55.03	.000	.000	.00
156	71.00 - 71.50	42.50 - 43.00	3.676	.271	28.72	.000	.000	.00
157	71.00 - 71.50	43.00 - 43.50	3.698	.251	42.22	.000	.000	.00
158	71.00 - 71.50	43.50 - 44.00	3.627	.221	34.16	.000	.000	.00
159	71.00 - 71.50	44.00 - 44.50	3.637	.215	62.95	.000	.000	.00
160	71.00 - 71.50	44.50 - 45.00	3.363	.050	46.80	.000	.000	.00
161	71.00 - 71.50	45.00 - 45.50	3.401	.219	75.19	.000	.000	.00
162	71.00 - 71.50	45.50 - 46.00	3.431	.354	101.03	.000	.000	.00
163	71.00 - 71.50	46.00 - 46.50	3.786	.503	124.07	.000	.000	.00
164	71.00 - 71.50	46.50 - 47.00	3.749	.551	94.18	.000	.000	.00
165	71.50 - 72.00	39.00 - 39.50	3.775	.232	209.82	3.429	.397	89.09
166	71.50 - 72.00	39.50 - 40.00	3.841	.203	191.05	3.429	.397	69.06
167	71.50 - 72.00	40.00 - 40.50	3.078	.246	93.56	2.896	.375	52.70
168	71.50 - 72.00	40.50 - 41.00	3.085	.245	71.74	2.746	.503	74.60
169	71.50 - 72.00	41.00 - 41.50	3.513	.352	79.40	2.746	.503	107.31
170	71.50 - 72.00	41.50 - 42.00	3.595	.304	57.44	.000	.000	.00
171	71.50 - 72.00	42.00 - 42.50	3.679	.268	65.37	.000	.000	.00
172	71.50 - 72.00	42.50 - 43.00	3.695	.271	45.20	.000	.000	.00
173	71.50 - 72.00	43.00 - 43.50	3.726	.242	49.52	.000	.000	.00
174	71.50 - 72.00	43.50 - 44.00	3.656	.215	61.23	.000	.000	.00
175	71.50 - 72.00	44.00 - 44.50	3.703	.221	81.01	.000	.000	.00

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
176	71.50 - 72.00	44.50 - 45.00	3.439	.210	68.31	.000	.000	.00
177	71.50 - 72.00	45.00 - 45.50	3.506	.319	95.87	.000	.000	.00
178	71.50 - 72.00	45.50 - 46.00	3.479	.449	109.68	.000	.000	.00
179	71.50 - 72.00	46.00 - 46.50	3.808	.540	128.77	.000	.000	.00
180	71.50 - 72.00	46.50 - 47.00	3.746	.618	102.82	.000	.000	.00
181	72.00 - 72.50	39.00 - 39.50	3.775	.232	199.86	3.429	.397	98.59
182	72.00 - 72.50	39.50 - 40.00	3.841	.203	180.36	3.429	.397	109.06
183	72.00 - 72.50	40.00 - 40.50	3.275	.165	93.50	2.896	.375	72.41
184	72.00 - 72.50	40.50 - 41.00	3.280	.162	72.24	2.746	.503	87.61
185	72.00 - 72.50	41.00 - 41.50	3.605	.315	73.21	2.746	.503	116.73
186	72.00 - 72.50	41.50 - 42.00	3.673	.274	59.33	.000	.000	.00
187	72.00 - 72.50	42.00 - 42.50	3.740	.246	73.53	.000	.000	.00
188	72.00 - 72.50	42.50 - 43.00	3.708	.260	70.22	.000	.000	.00
189	72.00 - 72.50	43.00 - 43.50	3.768	.221	76.48	.000	.000	.00
190	72.00 - 72.50	43.50 - 44.00	3.684	.208	79.38	.000	.000	.00
191	72.00 - 72.50	44.00 - 44.50	3.725	.212	89.40	.000	.000	.00
192	72.00 - 72.50	44.50 - 45.00	3.469	.216	57.86	.000	.000	.00
193	72.00 - 72.50	45.00 - 45.50	3.537	.311	95.17	.000	.000	.00
194	72.00 - 72.50	45.50 - 46.00	3.524	.427	107.21	.000	.000	.00
195	72.50 - 73.00	39.00 - 39.50	3.784	.225	189.59	3.429	.397	116.11
196	72.50 - 73.00	39.50 - 40.00	3.848	.195	169.22	3.429	.397	134.04
197	72.50 - 73.00	40.00 - 40.50	3.304	.133	82.74	2.896	.375	94.08
198	72.50 - 73.00	40.50 - 41.00	3.310	.129	62.47	2.746	.503	105.80
199	72.50 - 73.00	41.00 - 41.50	3.557	.260	51.25	2.746	.503	130.94
200	72.50 - 73.00	41.50 - 42.00	3.630	.217	27.35	.000	.000	.00
201	72.50 - 73.00	42.00 - 42.50	3.698	.194	70.19	.000	.000	.00
202	72.50 - 73.00	42.50 - 43.00	3.644	.225	78.65	.000	.000	.00
203	72.50 - 73.00	43.00 - 43.50	3.777	.230	90.07	.000	.000	.00
204	72.50 - 73.00	43.50 - 44.00	3.694	.224	84.76	.000	.000	.00
205	72.50 - 73.00	44.00 - 44.50	3.732	.225	86.43	.000	.000	.00
206	72.50 - 73.00	44.50 - 45.00	3.599	.188	72.31	2.071	.000	141.13
207	72.50 - 73.00	45.00 - 45.50	3.628	.337	93.00	2.071	.000	118.18
208	72.50 - 73.00	45.50 - 46.00	3.617	.443	102.01	2.071	.000	101.96
209	73.00 - 73.50	38.00 - 38.50	3.532	.009	183.00	3.429	.397	108.00
210	73.00 - 73.50	38.50 - 39.00	3.834	.242	220.33	3.497	.359	129.75

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID.	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
211	73.00 - 73.50	39.00 - 39.50	3.877	.216	194.71	3.497	.359	144.81
212	73.00 - 73.50	39.50 - 40.00	3.930	.193	171.02	3.497	.359	162.12
213	73.00 - 73.50	40.00 - 40.50	3.299	.138	69.35	2.896	.375	116.35
214	73.00 - 73.50	40.50 - 41.00	3.299	.138	48.95	2.746	.503	126.96
215	73.00 - 73.50	41.00 - 41.50	3.464	.208	45.07	2.746	.503	148.56
216	73.00 - 73.50	41.50 - 42.00	3.527	.181	43.60	.000	.000	.00
217	73.00 - 73.50	42.00 - 42.50	3.589	.177	70.14	.000	.000	.00
218	73.00 - 73.50	42.50 - 43.00	3.486	.226	72.02	.000	.000	.00
219	73.00 - 73.50	43.00 - 43.50	3.679	.215	77.92	.000	.000	.00
220	73.00 - 73.50	43.50 - 44.00	3.601	.199	61.49	.000	.000	.00
221	73.00 - 73.50	44.00 - 44.50	3.668	.212	63.70	.000	.000	.00
222	73.00 - 73.50	44.50 - 45.00	3.579	.211	43.71	2.071	.000	126.23
223	73.00 - 73.50	45.00 - 45.50	3.623	.344	77.25	2.071	.000	99.92
224	73.00 - 73.50	45.50 - 46.00	3.560	.377	71.21	2.071	.000	80.08
225	73.50 - 74.00	38.00 - 38.50	3.583	.051	179.04	3.429	.397	101.18
226	73.50 - 74.00	38.50 - 39.00	3.867	.228	214.95	3.497	.359	136.21
227	73.50 - 74.00	39.00 - 39.50	3.914	.198	191.50	3.497	.359	155.58
228	73.50 - 74.00	39.50 - 40.00	3.961	.180	165.79	3.497	.359	172.99
229	73.50 - 74.00	40.00 - 40.50	3.383	.120	62.18	2.296	.225	131.63
230	73.50 - 74.00	40.50 - 41.00	3.376	.129	29.50	.000	.000	.00
231	73.50 - 74.00	41.00 - 41.50	3.401	.108	40.92	.000	.000	.00
232	73.50 - 74.00	41.50 - 42.00	3.416	.078	52.74	.000	.000	.00
233	73.50 - 74.00	42.00 - 42.50	3.437	.059	66.59	.000	.000	.00
234	73.50 - 74.00	42.50 - 43.00	3.261	.144	54.77	.000	.000	.00
235	73.50 - 74.00	43.00 - 43.50	3.550	.167	41.06	.000	.000	.00
236	73.50 - 74.00	43.50 - 44.00	3.439	.130	48.43	.000	.000	.00
237	73.50 - 74.00	44.00 - 44.50	3.557	.191	59.47	.000	.000	.00
238	73.50 - 74.00	44.50 - 45.00	3.540	.209	39.66	2.071	.000	114.41
239	73.50 - 74.00	45.00 - 45.50	3.589	.344	64.19	2.071	.000	84.48
240	73.50 - 74.00	45.50 - 46.00	3.560	.377	36.45	2.071	.000	59.72
241	74.00 - 74.50	34.00 - 34.50	2.978	.054	277.09	3.179	.447	203.36
242	74.00 - 74.50	34.50 - 35.00	3.109	.129	256.83	3.241	.391	177.56
243	74.00 - 74.50	35.00 - 35.50	3.134	.123	234.30	3.241	.391	140.27
244	74.00 - 74.50	35.50 - 36.00	3.258	.082	244.02	3.365	.419	118.57
245	74.00 - 74.50	36.00 - 36.50	3.274	.060	223.75	3.429	.397	79.63

SEISMIC MAP OF CONTINENTAL U.S.

GFID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
246	74.00 - 74.50	36.50 - 37.00	3.487	.098	232.61	3.429	.397	29.65
247	74.00 - 74.50	37.00 - 37.50	3.506	.071	210.01	3.429	.397	17.02
248	74.00 - 74.50	37.50 - 38.00	3.580	.053	188.31	3.429	.397	56.72
249	74.00 - 74.50	38.00 - 38.50	3.583	.051	168.22	3.429	.397	98.30
250	74.00 - 74.50	38.50 - 39.00	3.867	.228	204.01	3.497	.359	139.46
251	74.00 - 74.50	39.00 - 39.50	3.916	.197	182.68	3.497	.359	161.75
252	74.00 - 74.50	39.50 - 40.00	3.963	.178	158.68	3.497	.359	178.79
253	74.00 - 74.50	40.00 - 40.50	3.383	.120	57.27	2.296	.225	149.65
254	74.00 - 74.50	40.50 - 41.00	3.376	.129	23.48	.000	.000	.00
255	74.00 - 74.50	41.00 - 41.50	3.381	.122	40.68	.000	.000	.00
256	74.00 - 74.50	41.50 - 42.00	3.389	.104	41.03	.000	.000	.00
257	74.00 - 74.50	42.00 - 42.50	3.408	.087	70.06	.000	.000	.00
258	74.00 - 74.50	42.50 - 43.00	3.213	.179	43.11	.000	.000	.00
259	74.00 - 74.50	43.00 - 43.50	3.523	.192	54.21	.000	.000	.00
260	74.00 - 74.50	43.50 - 44.00	3.412	.154	58.36	.000	.000	.00
261	74.00 - 74.50	44.00 - 44.50	3.536	.216	48.43	.000	.000	.00
262	74.00 - 74.50	44.50 - 45.00	3.532	.223	29.18	2.071	.000	106.68
263	74.00 - 74.50	45.00 - 45.50	3.589	.344	59.87	2.071	.000	73.69
264	74.00 - 74.50	45.50 - 46.00	3.560	.377	66.88	2.372	.000	61.12
265	74.50 - 75.00	34.00 - 34.50	2.978	.054	258.89	3.179	.447	205.37
266	74.50 - 75.00	34.50 - 35.00	3.109	.129	240.58	3.241	.391	180.35
267	74.50 - 75.00	35.00 - 35.50	3.134	.123	218.37	3.241	.391	143.79
268	74.50 - 75.00	35.50 - 36.00	3.258	.082	226.64	3.365	.419	124.34
269	74.50 - 75.00	36.00 - 36.50	3.274	.060	206.35	3.429	.397	91.01
270	74.50 - 75.00	36.50 - 37.00	3.487	.098	217.18	3.429	.397	57.58
271	74.50 - 75.00	37.00 - 37.50	3.506	.071	195.61	3.429	.397	45.88
272	74.50 - 75.00	37.50 - 38.00	3.580	.053	176.80	3.429	.397	69.53
273	74.50 - 75.00	38.00 - 38.50	3.583	.051	156.12	3.429	.397	105.36
274	74.50 - 75.00	38.50 - 39.00	3.867	.228	190.30	3.497	.359	145.45
275	74.50 - 75.00	39.00 - 39.50	3.923	.191	173.20	3.497	.359	166.27
276	74.50 - 75.00	39.50 - 40.00	3.969	.174	152.33	3.497	.359	180.08
277	74.50 - 75.00	40.00 - 40.50	3.383	.120	59.13	2.521	.367	105.80
278	74.50 - 75.00	40.50 - 41.00	3.376	.129	35.20	2.521	.367	111.28
279	74.50 - 75.00	41.00 - 41.50	3.381	.122	55.73	2.521	.367	126.31
280	74.50 - 75.00	41.50 - 42.00	3.389	.104	66.27	2.521	.367	148.01

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
281	74.50 - 75.00	42.00 - 42.50	3.408	.087	80.17	.000	.000	.00
282	74.50 - 75.00	42.50 - 43.00	3.213	.179	63.97	.000	.000	.00
283	74.50 - 75.00	43.00 - 43.50	3.519	.198	61.56	.000	.000	.00
284	74.50 - 75.00	43.50 - 44.00	3.438	.180	66.02	.000	.000	.00
285	74.50 - 75.00	44.00 - 44.50	3.556	.223	56.81	.000	.000	.00
286	74.50 - 75.00	44.50 - 45.00	3.551	.230	24.59	2.071	.000	103.98
287	74.50 - 75.00	45.00 - 45.50	3.610	.345	57.19	2.071	.000	69.72
288	74.50 - 75.00	45.50 - 46.00	3.582	.379	81.80	2.372	.000	51.41
289	75.00 - 75.50	34.00 - 34.50	2.978	.054	240.97	3.179	.447	211.26
290	75.00 - 75.50	34.50 - 35.00	3.109	.129	224.94	3.241	.391	187.92
291	75.00 - 75.50	35.00 - 35.50	3.134	.123	203.23	3.241	.391	153.36
292	75.00 - 75.50	35.50 - 36.00	3.258	.082	210.11	3.365	.419	138.90
293	75.00 - 75.50	36.00 - 36.50	3.274	.060	189.66	3.429	.397	114.10
294	75.00 - 75.50	36.50 - 37.00	3.740	.372	243.06	3.482	.380	95.63
295	75.00 - 75.50	37.00 - 37.50	3.528	.076	184.82	3.482	.380	87.61
296	75.00 - 75.50	37.50 - 38.00	3.580	.053	164.88	3.429	.397	95.50
297	75.00 - 75.50	38.00 - 38.50	3.583	.051	141.60	3.429	.397	120.91
298	75.00 - 75.50	38.50 - 39.00	3.867	.228	165.79	3.497	.359	154.99
299	75.00 - 75.50	39.00 - 39.50	3.923	.191	157.82	3.497	.359	169.66
300	75.00 - 75.50	39.50 - 40.00	3.969	.174	133.72	3.497	.359	175.48
301	75.00 - 75.50	40.00 - 40.50	3.233	.112	41.46	2.521	.367	79.63
302	75.00 - 75.50	40.50 - 41.00	3.222	.123	45.64	2.521	.367	86.78
303	75.00 - 75.50	41.00 - 41.50	3.230	.115	59.83	2.521	.367	105.36
304	75.00 - 75.50	41.50 - 42.00	3.242	.090	75.77	2.521	.367	130.58
305	75.00 - 75.50	42.00 - 42.50	3.275	.068	88.30	.000	.000	.00
306	75.00 - 75.50	42.50 - 43.00	2.881	.153	57.01	.000	.000	.00
307	75.00 - 75.50	43.00 - 43.50	3.380	.127	76.31	.000	.000	.00
308	75.00 - 75.50	43.50 - 44.00	3.438	.180	67.95	.000	.000	.00
309	75.00 - 75.50	44.00 - 44.50	3.556	.223	65.03	.000	.000	.00
310	75.00 - 75.50	44.50 - 45.00	3.551	.230	38.80	2.071	.000	106.68
311	75.00 - 75.50	45.00 - 45.50	3.512	.257	36.72	2.071	.000	73.69
312	75.00 - 75.50	45.50 - 46.00	3.483	.294	77.56	2.372	.000	59.19
313	75.50 - 76.00	34.00 - 34.50	3.602	.429	264.69	3.273	.411	230.33
314	75.50 - 76.00	34.50 - 35.00	3.635	.410	261.41	3.321	.367	209.81
315	75.50 - 76.00	35.00 - 35.50	3.644	.402	256.11	3.321	.367	179.72

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
316	75.50 - 76.00	35.50 - 36.00	3.669	.395	251.76	3.429	.397	169.34
317	75.50 - 76.00	36.00 - 36.50	3.675	.390	239.19	3.482	.380	149.20
318	75.50 - 76.00	36.50 - 37.00	3.858	.285	247.52	3.509	.340	133.01
319	75.50 - 76.00	37.00 - 37.50	3.611	.104	176.00	3.509	.340	126.93
320	75.50 - 76.00	37.50 - 38.00	3.722	.118	176.77	3.446	.373	125.99
321	75.50 - 76.00	38.00 - 38.50	3.737	.107	153.13	3.446	.373	142.75
322	75.50 - 76.00	38.50 - 39.00	3.903	.222	110.58	3.509	.340	167.77
323	75.50 - 76.00	39.00 - 39.50	3.955	.187	150.08	3.509	.340	172.35
324	75.50 - 76.00	39.50 - 40.00	3.993	.177	83.46	3.509	.340	163.13
325	75.50 - 76.00	40.00 - 40.50	3.228	.117	51.17	2.521	.367	53.60
326	75.50 - 76.00	40.50 - 41.00	3.216	.128	31.04	2.521	.367	63.75
327	75.50 - 76.00	41.00 - 41.50	3.213	.132	67.43	2.521	.367	87.37
328	75.50 - 76.00	41.50 - 42.00	3.228	.100	89.79	2.521	.367	116.56
329	75.50 - 76.00	42.00 - 42.50	3.254	.091	103.20	.000	.000	.00
330	75.50 - 76.00	42.50 - 43.00	2.839	.107	70.31	.000	.000	.00
331	75.50 - 76.00	43.00 - 43.50	3.335	.177	86.53	.000	.000	.00
332	75.50 - 76.00	43.50 - 44.00	3.401	.218	46.96	.000	.000	.00
333	75.50 - 76.00	44.00 - 44.50	3.527	.260	75.71	.000	.000	.00
334	75.50 - 76.00	44.50 - 45.00	3.521	.270	53.08	2.372	.000	125.98
335	75.50 - 76.00	45.00 - 45.50	3.476	.306	61.91	2.372	.000	97.76
336	75.50 - 76.00	45.50 - 46.00	3.447	.340	85.95	2.548	.000	81.69
337	76.00 - 76.50	33.00 - 33.50	3.660	.446	263.95	3.317	.349	283.80
338	76.00 - 76.50	33.50 - 34.00	3.744	.366	268.41	3.317	.349	261.89
339	76.00 - 76.50	34.00 - 34.50	3.744	.366	267.71	3.317	.349	239.51
340	76.00 - 76.50	34.50 - 35.00	3.773	.339	265.87	3.358	.313	223.32
341	76.00 - 76.50	35.00 - 35.50	3.781	.328	260.87	3.358	.313	198.99
342	76.00 - 76.50	35.50 - 36.00	3.799	.322	254.66	3.358	.313	175.54
343	76.00 - 76.50	36.00 - 36.50	3.804	.315	241.01	3.416	.303	163.34
344	76.00 - 76.50	36.50 - 37.00	3.871	.274	225.05	3.535	.318	168.39
345	76.00 - 76.50	37.00 - 37.50	3.636	.088	158.86	3.535	.318	163.13
346	76.00 - 76.50	37.50 - 38.00	3.739	.103	161.60	3.477	.346	157.80
347	76.00 - 76.50	38.00 - 38.50	3.751	.096	147.87	3.477	.346	167.55
348	76.00 - 76.50	38.50 - 39.00	3.874	.181	151.67	3.535	.318	183.16
349	76.00 - 76.50	39.00 - 39.50	3.918	.153	150.64	3.535	.318	175.75
350	76.00 - 76.50	39.50 - 40.00	3.952	.149	134.38	3.535	.318	142.54

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
351	76.00 - 76.50	40.00 - 40.50	3.269	.113	48.73	2.521	.367	28.17
352	76.00 - 76.50	40.50 - 41.00	3.159	.166	58.10	2.521	.367	44.54
353	76.00 - 76.50	41.00 - 41.50	3.289	.218	90.29	2.881	.298	100.12
354	76.00 - 76.50	41.50 - 42.00	3.244	.192	104.89	2.881	.298	116.39
355	76.00 - 76.50	42.00 - 42.50	3.260	.184	113.96	2.621	.255	107.51
356	76.00 - 76.50	42.50 - 43.00	2.982	.304	89.75	2.621	.255	101.83
357	76.00 - 76.50	43.00 - 43.50	3.378	.296	105.21	2.621	.255	107.51
358	76.00 - 76.50	43.50 - 44.00	3.447	.306	88.21	2.621	.255	123.00
359	76.00 - 76.50	44.00 - 44.50	3.447	.306	86.07	2.621	.255	145.19
360	76.00 - 76.50	44.50 - 45.00	3.319	.257	64.42	2.372	.000	126.23
361	76.00 - 76.50	45.00 - 45.50	3.298	.290	60.15	2.372	.000	99.91
362	76.00 - 76.50	45.50 - 46.00	3.267	.312	80.98	2.548	.000	86.37
363	76.50 - 77.00	33.00 - 33.50	3.716	.382	237.58	3.358	.313	285.37
364	76.50 - 77.00	33.50 - 34.00	3.781	.328	239.83	3.358	.313	266.99
365	76.50 - 77.00	34.00 - 34.50	3.781	.328	239.91	3.358	.313	248.97
366	76.50 - 77.00	34.50 - 35.00	3.804	.310	240.34	3.392	.285	236.08
367	76.50 - 77.00	35.00 - 35.50	3.810	.302	237.75	3.392	.285	216.98
368	76.50 - 77.00	35.50 - 36.00	3.827	.296	233.22	3.392	.285	198.79
369	76.50 - 77.00	36.00 - 36.50	3.831	.291	219.57	3.446	.278	190.25
370	76.50 - 77.00	36.50 - 37.00	3.883	.273	205.68	3.511	.244	186.65
371	76.50 - 77.00	37.00 - 37.50	3.664	.108	142.29	3.511	.244	182.75
372	76.50 - 77.00	37.50 - 38.00	3.768	.102	144.16	3.457	.261	176.38
373	76.50 - 77.00	38.00 - 38.50	3.779	.095	139.43	3.446	.278	179.79
374	76.50 - 77.00	38.50 - 39.00	3.847	.139	147.02	3.502	.259	187.97
375	76.50 - 77.00	39.00 - 39.50	3.869	.115	145.71	3.502	.259	172.38
376	76.50 - 77.00	39.50 - 40.00	3.877	.110	143.78	3.502	.259	121.49
377	76.50 - 77.00	40.00 - 40.50	3.039	.116	62.73	2.521	.367	10.00
378	76.50 - 77.00	40.50 - 41.00	2.885	.067	65.11	2.521	.367	35.92
379	76.50 - 77.00	41.00 - 41.50	3.115	.277	102.33	2.881	.298	92.10
380	76.50 - 77.00	41.50 - 42.00	3.055	.265	104.00	2.881	.298	104.44
381	76.50 - 77.00	42.00 - 42.50	3.068	.281	100.11	2.621	.255	84.06
382	76.50 - 77.00	42.50 - 43.00	2.954	.343	86.38	2.621	.255	76.66
383	76.50 - 77.00	43.00 - 43.50	3.275	.368	106.23	2.621	.255	84.06
384	76.50 - 77.00	43.50 - 44.00	3.384	.345	106.60	2.621	.255	103.14
385	76.50 - 77.00	44.00 - 44.50	3.384	.345	100.80	2.621	.255	128.80

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
386	76.50 - 77.00	44.50 - 45.00	3.253	.281	75.53	2.372	.000	125.98
387	76.50 - 77.00	45.00 - 45.50	3.204	.329	33.84	2.372	.000	97.76
388	76.50 - 77.00	45.50 - 46.00	3.160	.363	79.45	2.548	.000	81.69
389	77.00 - 77.50	32.00 - 32.50	3.585	.440	186.47	2.680	.206	183.80
390	77.00 - 77.50	32.50 - 33.00	3.591	.433	181.21	2.922	.255	214.69
391	77.00 - 77.50	33.00 - 33.50	3.744	.366	210.60	3.440	.269	281.47
392	77.00 - 77.50	33.50 - 34.00	3.802	.318	212.88	3.440	.269	267.12
393	77.00 - 77.50	34.00 - 34.50	3.802	.318	212.74	3.440	.269	254.19
394	77.00 - 77.50	34.50 - 35.00	3.821	.304	218.57	3.440	.269	241.34
395	77.00 - 77.50	35.00 - 35.50	3.827	.296	220.68	3.440	.269	228.24
396	77.00 - 77.50	35.50 - 36.00	3.842	.293	217.58	3.440	.269	215.69
397	77.00 - 77.50	36.00 - 36.50	3.846	.288	203.59	3.487	.264	210.07
398	77.00 - 77.50	36.50 - 37.00	3.909	.264	186.49	3.576	.218	212.13
399	77.00 - 77.50	37.00 - 37.50	3.711	.128	122.92	3.576	.218	208.27
400	77.00 - 77.50	37.50 - 38.00	3.812	.096	114.70	3.533	.227	202.47
401	77.00 - 77.50	38.00 - 38.50	3.821	.092	122.26	3.524	.241	202.64
402	77.00 - 77.50	38.50 - 39.00	3.879	.131	133.41	3.569	.229	204.76
403	77.00 - 77.50	39.00 - 39.50	3.897	.112	135.21	3.569	.229	189.30
404	77.00 - 77.50	39.50 - 40.00	3.904	.108	151.06	3.569	.229	150.32
405	77.00 - 77.50	40.00 - 40.50	2.998	.083	76.02	2.521	.367	28.17
406	77.00 - 77.50	40.50 - 41.00	2.802	.107	79.10	2.521	.367	44.54
407	77.00 - 77.50	41.00 - 41.50	3.062	.317	112.77	2.881	.298	92.53
408	77.00 - 77.50	41.50 - 42.00	3.008	.285	98.00	2.881	.298	94.94
409	77.00 - 77.50	42.00 - 42.50	3.027	.294	81.45	2.621	.255	62.11
410	77.00 - 77.50	42.50 - 43.00	2.954	.343	64.54	2.621	.255	51.65
411	77.00 - 77.50	43.00 - 43.50	3.027	.294	75.12	2.621	.255	62.11
412	77.00 - 77.50	43.50 - 44.00	3.212	.253	100.27	2.621	.255	86.19
413	77.00 - 77.50	44.00 - 44.50	3.212	.253	103.77	2.621	.255	115.67
414	77.00 - 77.50	44.50 - 45.00	3.010	.199	77.42	2.071	.000	106.68
415	77.50 - 78.00	32.00 - 32.50	3.608	.424	161.68	2.680	.206	159.37
416	77.50 - 78.00	32.50 - 33.00	3.627	.411	157.95	2.922	.255	189.93
417	77.50 - 78.00	33.00 - 33.50	3.773	.339	184.28	3.477	.233	270.05
418	77.50 - 78.00	33.50 - 34.00	3.824	.300	184.62	3.477	.233	259.10
419	77.50 - 78.00	34.00 - 34.50	3.815	.306	174.06	3.477	.233	250.72
420	77.50 - 78.00	34.50 - 35.00	3.832	.295	193.41	3.477	.233	242.51

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
421	77.50 - 78.00	35.00 - 35.50	3.853	.284	205.38	3.477	.233	233.56
422	77.50 - 78.00	35.50 - 36.00	3.873	.278	204.09	3.520	.232	231.58
423	77.50 - 78.00	36.00 - 36.50	3.877	.274	190.21	3.557	.233	225.82
424	77.50 - 78.00	36.50 - 37.00	3.936	.253	170.77	3.557	.233	218.95
425	77.50 - 78.00	37.00 - 37.50	3.758	.143	105.17	3.557	.233	215.59
426	77.50 - 78.00	37.50 - 38.00	3.854	.091	64.60	3.511	.244	209.43
427	77.50 - 78.00	38.00 - 38.50	3.854	.091	102.18	3.502	.259	208.86
428	77.50 - 78.00	38.50 - 39.00	3.910	.120	106.15	3.549	.245	210.76
429	77.50 - 78.00	39.00 - 39.50	3.927	.103	94.40	3.549	.245	199.97
430	77.50 - 78.00	39.50 - 40.00	3.924	.106	148.97	3.549	.245	179.78
431	77.50 - 78.00	40.00 - 40.50	2.985	.096	83.49	2.521	.367	53.60
432	77.50 - 78.00	40.50 - 41.00	2.781	.122	95.53	2.521	.367	63.75
433	77.50 - 78.00	41.00 - 41.50	3.043	.340	121.05	2.881	.298	97.93
434	77.50 - 78.00	41.50 - 42.00	3.042	.278	93.31	2.881	.298	88.05
435	77.50 - 78.00	42.00 - 42.50	3.068	.281	64.23	2.621	.255	43.95
436	77.50 - 78.00	42.50 - 43.00	3.009	.315	39.26	2.621	.255	27.24
437	77.50 - 78.00	43.00 - 43.50	3.027	.294	56.08	2.621	.255	43.95
438	77.50 - 78.00	43.50 - 44.00	3.131	.271	86.81	2.621	.255	74.18
439	77.50 - 78.00	44.00 - 44.50	3.131	.271	104.48	2.621	.255	107.02
440	77.50 - 78.00	44.50 - 45.00	2.848	.171	87.73	2.071	.000	103.98
441	78.00 - 78.50	31.00 - 31.50	3.631	.415	171.39	2.680	.206	176.02
442	78.00 - 78.50	31.50 - 32.00	3.665	.399	156.45	2.680	.206	153.96
443	78.00 - 78.50	32.00 - 32.50	3.669	.395	141.81	2.680	.206	135.63
444	78.00 - 78.50	32.50 - 33.00	3.684	.388	136.48	2.922	.255	162.16
445	78.00 - 78.50	33.00 - 33.50	3.818	.309	160.10	3.477	.233	247.02
446	78.00 - 78.50	33.50 - 34.00	3.860	.280	161.26	3.477	.233	240.65
447	78.00 - 78.50	34.00 - 34.50	3.853	.284	105.69	3.477	.233	238.51
448	78.00 - 78.50	34.50 - 35.00	3.867	.276	174.87	3.477	.233	235.90
449	78.00 - 78.50	35.00 - 35.50	3.887	.266	191.30	3.477	.233	230.96
450	78.00 - 78.50	35.50 - 36.00	3.905	.263	191.47	3.520	.232	230.88
451	78.00 - 78.50	36.00 - 36.50	3.908	.259	179.09	3.557	.233	226.49
452	78.00 - 78.50	36.50 - 37.00	3.938	.251	158.81	3.576	.218	222.87
453	78.00 - 78.50	37.00 - 37.50	3.758	.142	92.38	3.576	.218	219.93
454	78.00 - 78.50	37.50 - 38.00	3.760	.133	43.71	3.511	.244	211.39
455	78.00 - 78.50	38.00 - 38.50	3.777	.149	79.85	3.502	.259	211.81

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
456	78.00 - 78.50	38.50 - 39.00	3.860	.111	51.98	3.549	.245	215.81
457	78.00 - 78.50	39.00 - 39.50	3.877	.097	84.59	3.549	.245	211.11
458	78.00 - 78.50	39.50 - 40.00	3.874	.099	140.76	3.549	.245	203.23
459	78.00 - 78.50	40.00 - 40.50	2.782	.112	82.12	2.521	.367	79.63
460	78.00 - 78.50	40.50 - 41.00	2.432	.000	102.99	2.521	.367	86.78
461	78.00 - 78.50	41.00 - 41.50	2.742	.497	104.80	2.881	.298	105.53
462	78.00 - 78.50	41.50 - 42.00	2.975	.318	86.06	2.881	.298	86.54
463	78.00 - 78.50	42.00 - 42.50	2.954	.343	47.25	2.621	.255	35.92
464	78.00 - 78.50	42.50 - 43.00	2.954	.343	14.28	2.621	.255	10.00
465	78.00 - 78.50	43.00 - 43.50	2.954	.343	38.46	2.621	.255	35.92
466	78.00 - 78.50	43.50 - 44.00	3.068	.326	73.70	2.621	.255	69.72
467	78.00 - 78.50	44.00 - 44.50	3.068	.326	102.50	2.621	.255	103.98
468	78.00 - 78.50	44.50 - 45.00	2.739	.217	98.42	2.071	.000	106.68
469	78.50 - 79.00	31.00 - 31.50	3.635	.410	150.65	2.822	.122	179.04
470	78.50 - 79.00	31.50 - 32.00	3.669	.395	131.75	2.822	.122	153.47
471	78.50 - 79.00	32.00 - 32.50	3.673	.392	113.55	2.822	.122	130.69
472	78.50 - 79.00	32.50 - 33.00	3.687	.385	106.77	3.013	.205	143.44
473	78.50 - 79.00	33.00 - 33.50	3.821	.304	130.60	3.500	.214	215.14
474	78.50 - 79.00	33.50 - 34.00	3.863	.277	144.63	3.500	.214	215.24
475	78.50 - 79.00	34.00 - 34.50	3.855	.281	148.55	3.500	.214	222.09
476	78.50 - 79.00	34.50 - 35.00	3.870	.273	167.97	3.500	.214	226.68
477	78.50 - 79.00	35.00 - 35.50	3.889	.263	179.37	3.500	.214	226.11
478	78.50 - 79.00	35.50 - 36.00	3.907	.260	179.94	3.541	.215	227.17
479	78.50 - 79.00	36.00 - 36.50	3.910	.257	169.06	3.576	.218	223.06
480	78.50 - 79.00	36.50 - 37.00	3.960	.246	153.64	3.576	.218	215.97
481	78.50 - 79.00	37.00 - 37.50	3.795	.161	94.76	3.576	.218	212.69
482	78.50 - 79.00	37.50 - 38.00	3.795	.154	42.66	3.511	.244	205.66
483	78.50 - 79.00	38.00 - 38.50	3.802	.166	86.47	3.502	.259	208.73
484	78.50 - 79.00	38.50 - 39.00	3.883	.120	102.38	3.549	.245	216.62
485	78.50 - 79.00	39.00 - 39.50	3.900	.107	124.70	3.549	.245	217.38
486	78.50 - 79.00	39.50 - 40.00	3.897	.108	153.26	3.549	.245	216.72
487	78.50 - 79.00	40.00 - 40.50	2.744	.149	87.81	2.521	.367	105.80
488	78.50 - 79.00	40.50 - 41.00	2.531	.061	105.31	2.521	.367	111.28
489	78.50 - 79.00	41.00 - 41.50	2.874	.410	113.34	2.881	.298	115.60
490	78.50 - 79.00	41.50 - 42.00	3.025	.309	86.90	2.881	.298	93.37

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
491	78.50 - 79.00	42.00 - 42.50	3.025	.309	56.72	2.621	.255	43.95
492	78.50 - 79.00	42.50 - 43.00	3.025	.309	35.81	2.621	.255	27.24
493	78.50 - 79.00	43.00 - 43.50	3.025	.309	26.73	2.621	.255	43.95
494	78.50 - 79.00	43.50 - 44.00	3.128	.286	70.08	2.621	.255	74.18
495	78.50 - 79.00	44.00 - 44.50	3.068	.326	100.91	2.621	.255	107.02
496	78.50 - 79.00	44.50 - 45.00	2.739	.217	105.02	2.071	.000	114.41
497	79.00 - 79.50	25.00 - 25.50	2.688	.671	197.40	.000	.000	.00
498	79.00 - 79.50	25.50 - 26.00	2.906	.485	273.28	.000	.000	.00
499	79.00 - 79.50	26.00 - 26.50	2.960	.414	298.07	.000	.000	.00
500	79.00 - 79.50	26.50 - 27.00	2.960	.414	309.39	.000	.000	.00
501	79.00 - 79.50	27.00 - 27.50	2.478	.149	241.67	.000	.000	.00
502	79.00 - 79.50	27.50 - 28.00	2.478	.149	218.59	.000	.000	.00
503	79.00 - 79.50	28.00 - 28.50	2.779	.149	235.95	.000	.000	.00
504	79.00 - 79.50	28.50 - 29.00	3.527	.478	264.56	.000	.000	.00
505	79.00 - 79.50	29.00 - 29.50	3.555	.456	235.66	2.780	.175	289.08
506	79.00 - 79.50	29.50 - 30.00	3.587	.439	210.74	2.822	.122	251.61
507	79.00 - 79.50	30.00 - 30.50	3.593	.433	183.09	2.822	.122	222.20
508	79.00 - 79.50	30.50 - 31.00	3.626	.420	160.92	2.822	.122	192.98
509	79.00 - 79.50	31.00 - 31.50	3.648	.405	134.50	2.822	.122	164.00
510	79.00 - 79.50	31.50 - 32.00	3.684	.388	110.76	2.822	.122	135.48
511	79.00 - 79.50	32.00 - 32.50	3.708	.382	88.83	2.822	.122	108.31
512	79.00 - 79.50	32.50 - 33.00	3.729	.374	79.01	2.822	.122	85.59
513	79.00 - 79.50	33.00 - 33.50	3.855	.287	103.07	3.187	.085	116.88
514	79.00 - 79.50	33.50 - 34.00	3.891	.266	128.22	3.187	.085	126.61
515	79.00 - 79.50	34.00 - 34.50	3.885	.269	147.15	3.187	.085	146.25
516	79.00 - 79.50	34.50 - 35.00	3.899	.261	162.05	3.187	.085	161.14
517	79.00 - 79.50	35.00 - 35.50	3.916	.253	169.66	3.187	.085	167.03
518	79.00 - 79.50	35.50 - 36.00	3.932	.252	169.71	3.286	.137	181.59
519	79.00 - 79.50	36.00 - 36.50	3.935	.249	160.40	3.363	.173	184.96
520	79.00 - 79.50	36.50 - 37.00	4.052	.230	160.92	3.576	.218	201.16
521	79.00 - 79.50	37.00 - 37.50	3.961	.159	126.02	3.576	.218	196.37
522	79.00 - 79.50	37.50 - 38.00	3.962	.151	106.14	3.511	.244	191.43
523	79.00 - 79.50	38.00 - 38.50	3.966	.162	123.91	3.502	.259	199.05
524	79.00 - 79.50	38.50 - 39.00	4.015	.162	147.67	3.549	.245	212.32
525	79.00 - 79.50	39.00 - 39.50	4.018	.144	162.25	3.549	.245	217.91

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
526	79.00 - 79.50	39.50 - 40.00	4.011	.153	177.83	3.549	.245	222.10
527	79.00 - 79.50	40.00 - 40.50	2.793	.101	97.52	.000	.000	.00
528	79.00 - 79.50	40.50 - 41.00	2.594	.001	95.75	.000	.000	.00
529	79.00 - 79.50	41.00 - 41.50	2.914	.362	107.39	2.621	.255	115.67
530	79.00 - 79.50	41.50 - 42.00	3.047	.283	87.50	2.621	.255	86.19
531	79.00 - 79.50	42.00 - 42.50	3.047	.283	67.05	2.621	.255	62.11
532	79.00 - 79.50	42.50 - 43.00	3.047	.283	50.98	2.621	.255	51.65
533	79.00 - 79.50	43.00 - 43.50	3.025	.309	32.16	2.621	.255	62.11
534	79.00 - 79.50	43.50 - 44.00	3.025	.309	62.35	2.621	.255	86.19
535	79.00 - 79.50	44.00 - 44.50	2.954	.343	93.98	2.621	.255	115.67
536	79.00 - 79.50	44.50 - 45.00	2.557	.212	104.94	2.071	.000	126.23
537	79.00 - 79.50	45.00 - 45.50	2.592	.671	103.98	2.071	.000	99.92
538	79.00 - 79.50	45.50 - 46.00	2.592	.671	69.72	2.071	.000	80.08
539	79.00 - 79.50	46.00 - 46.50	2.592	.671	35.92	2.071	.000	72.27
540	79.00 - 79.50	46.50 - 47.00	2.592	.671	10.00	2.071	.000	80.08
541	79.50 - 80.00	25.00 - 25.50	2.688	.671	184.13	.000	.000	.00
542	79.50 - 80.00	25.50 - 26.00	2.906	.485	259.83	.000	.000	.00
543	79.50 - 80.00	26.00 - 26.50	2.960	.414	285.34	.000	.000	.00
544	79.50 - 80.00	26.50 - 27.00	2.960	.414	295.80	.000	.000	.00
545	79.50 - 80.00	27.00 - 27.50	2.478	.149	223.16	.000	.000	.00
546	79.50 - 80.00	27.50 - 28.00	2.478	.149	198.00	.000	.000	.00
547	79.50 - 80.00	28.00 - 28.50	2.779	.149	214.90	.000	.000	.00
548	79.50 - 80.00	28.50 - 29.00	3.527	.478	253.75	.000	.000	.00
549	79.50 - 80.00	29.00 - 29.50	3.555	.456	224.67	2.780	.175	281.64
550	79.50 - 80.00	29.50 - 30.00	3.587	.439	199.65	2.822	.122	243.52
551	79.50 - 80.00	30.00 - 30.50	3.593	.433	172.42	2.822	.122	213.35
552	79.50 - 80.00	30.50 - 31.00	3.626	.420	149.68	2.822	.122	183.16
553	79.50 - 80.00	31.00 - 31.50	3.656	.397	122.31	2.822	.122	152.79
554	79.50 - 80.00	31.50 - 32.00	3.694	.379	94.15	2.822	.122	122.01
555	79.50 - 80.00	32.00 - 32.50	3.729	.370	63.91	2.822	.122	90.72
556	79.50 - 80.00	32.50 - 33.00	3.747	.365	44.66	2.822	.122	60.16
557	79.50 - 80.00	33.00 - 33.50	3.872	.270	72.75	3.187	.085	69.22
558	79.50 - 80.00	33.50 - 34.00	3.905	.254	110.06	3.187	.085	93.41
559	79.50 - 80.00	34.00 - 34.50	3.899	.256	136.43	3.187	.085	126.01
560	79.50 - 80.00	34.50 - 35.00	3.912	.250	151.53	3.187	.085	146.26

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
561	79.50 - 80.00	35.00 - 35.50	3.929	.244	157.28	3.187	.085	153.02
562	79.50 - 80.00	35.50 - 36.00	3.944	.243	157.36	3.286	.137	164.35
563	79.50 - 80.00	36.00 - 36.50	3.974	.245	151.87	3.363	.173	163.03
564	79.50 - 80.00	36.50 - 37.00	4.042	.225	146.73	3.363	.173	146.11
565	79.50 - 80.00	37.00 - 37.50	3.941	.144	119.74	3.363	.173	137.44
566	79.50 - 80.00	37.50 - 38.00	3.938	.139	120.59	3.231	.173	126.06
567	79.50 - 80.00	38.00 - 38.50	3.943	.151	133.41	3.214	.194	138.18
568	79.50 - 80.00	38.50 - 39.00	3.991	.158	155.91	3.314	.205	165.63
569	79.50 - 80.00	39.00 - 39.50	3.993	.142	167.49	3.314	.205	173.85
570	79.50 - 80.00	39.50 - 40.00	3.986	.153	177.40	3.314	.205	179.57
571	79.50 - 80.00	40.00 - 40.50	2.895	.001	100.49	.000	.000	.00
572	79.50 - 80.00	40.50 - 41.00	2.715	.123	78.96	.000	.000	.00
573	79.50 - 80.00	41.00 - 41.50	2.985	.296	90.08	2.621	.255	128.80
574	79.50 - 80.00	41.50 - 42.00	3.094	.239	79.28	2.621	.255	103.14
575	79.50 - 80.00	42.00 - 42.50	3.094	.239	67.61	2.621	.255	84.06
576	79.50 - 80.00	42.50 - 43.00	3.094	.239	58.39	2.621	.255	76.66
577	79.50 - 80.00	43.00 - 43.50	3.065	.264	30.42	2.621	.255	84.06
578	79.50 - 80.00	43.50 - 44.00	3.025	.309	67.22	2.621	.255	103.14
579	79.50 - 80.00	44.00 - 44.50	2.954	.343	100.41	2.621	.255	128.80
580	79.50 - 80.00	44.50 - 45.00	2.557	.212	107.41	2.071	.000	141.13
581	79.50 - 80.00	45.00 - 45.50	2.592	.671	106.63	2.071	.000	118.18
582	79.50 - 80.00	45.50 - 46.00	2.592	.671	73.62	2.071	.000	101.96
583	79.50 - 80.00	46.00 - 46.50	2.592	.671	43.00	2.071	.000	95.95
584	79.50 - 80.00	46.50 - 47.00	2.592	.671	25.67	2.071	.000	101.96
585	80.00 - 80.50	25.00 - 25.50	2.688	.671	175.69	.000	.000	.00
586	80.00 - 80.50	25.50 - 26.00	2.906	.485	250.84	.000	.000	.00
587	80.00 - 80.50	26.00 - 26.50	2.960	.414	276.17	.000	.000	.00
588	80.00 - 80.50	26.50 - 27.00	2.960	.414	285.14	.000	.000	.00
589	80.00 - 80.50	27.00 - 27.50	2.478	.149	206.91	.000	.000	.00
590	80.00 - 80.50	27.50 - 28.00	2.478	.149	179.55	.000	.000	.00
591	80.00 - 80.50	28.00 - 28.50	2.779	.149	194.97	.000	.000	.00
592	80.00 - 80.50	28.50 - 29.00	3.527	.478	243.50	.000	.000	.00
593	80.00 - 80.50	29.00 - 29.50	3.555	.456	213.95	2.780	.175	276.58
594	80.00 - 80.50	29.50 - 30.00	3.587	.439	189.17	2.822	.122	237.94
595	80.00 - 80.50	30.00 - 30.50	3.593	.433	163.68	2.822	.122	207.42

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
596	80.00 - 80.50	30.50 - 31.00	3.626	.420	142.45	2.822	.122	176.83
597	80.00 - 80.50	31.00 - 31.50	3.656	.397	115.31	2.822	.122	145.98
598	80.00 - 80.50	31.50 - 32.00	3.697	.377	85.87	2.822	.122	114.44
599	80.00 - 80.50	32.00 - 32.50	3.731	.368	50.32	2.822	.122	81.47
600	80.00 - 80.50	32.50 - 33.00	3.750	.363	15.37	2.822	.122	46.16
601	80.00 - 80.50	33.00 - 33.50	3.874	.268	48.16	3.187	.085	25.14
602	80.00 - 80.50	33.50 - 34.00	3.907	.252	100.01	3.187	.085	73.20
603	80.00 - 80.50	34.00 - 34.50	3.901	.254	128.65	3.187	.085	113.47
604	80.00 - 80.50	34.50 - 35.00	3.914	.248	140.56	3.187	.085	135.86
605	80.00 - 80.50	35.00 - 35.50	3.930	.242	139.69	3.187	.085	142.22
606	80.00 - 80.50	35.50 - 36.00	3.945	.242	143.84	3.286	.137	149.70
607	80.00 - 80.50	36.00 - 36.50	3.974	.245	137.83	3.363	.173	142.21
608	80.00 - 80.50	36.50 - 37.00	4.042	.221	124.01	3.363	.173	115.74
609	80.00 - 80.50	37.00 - 37.50	3.998	.136	95.49	3.363	.173	96.85
610	80.00 - 80.50	37.50 - 38.00	3.995	.132	119.67	3.231	.173	98.40
611	80.00 - 80.50	38.00 - 38.50	4.007	.143	147.26	3.214	.194	118.95
612	80.00 - 80.50	38.50 - 39.00	4.055	.148	173.25	3.314	.205	150.98
613	80.00 - 80.50	39.00 - 39.50	4.055	.135	182.94	3.314	.205	161.54
614	80.00 - 80.50	39.50 - 40.00	4.044	.151	189.20	3.314	.205	169.01
615	80.00 - 80.50	40.00 - 40.50	4.021	.163	189.77	3.314	.205	178.02
616	80.00 - 80.50	40.50 - 41.00	4.002	.166	184.74	3.314	.205	188.22
617	80.00 - 80.50	41.00 - 41.50	4.007	.185	179.77	3.314	.205	195.80
618	80.00 - 80.50	41.50 - 42.00	3.928	.162	155.12	3.040	.318	156.51
619	80.00 - 80.50	42.00 - 42.50	3.883	.177	131.71	3.072	.282	155.13
620	80.00 - 80.50	42.50 - 43.00	3.938	.203	158.44	3.072	.282	154.52
621	80.00 - 80.50	43.00 - 43.50	3.985	.242	168.83	3.121	.234	169.47
622	80.00 - 80.50	43.50 - 44.00	3.961	.255	201.11	3.121	.234	186.49
623	80.00 - 80.50	44.00 - 44.50	3.936	.259	231.40	2.981	.206	182.06
624	80.00 - 80.50	44.50 - 45.00	3.875	.270	244.85	2.754	.184	154.43
625	80.00 - 80.50	45.00 - 45.50	3.733	.252	231.12	2.754	.184	161.56
626	80.00 - 80.50	45.50 - 46.00	3.721	.269	227.84	2.754	.184	165.57
627	80.00 - 80.50	46.00 - 46.50	3.700	.301	204.17	2.754	.184	170.08
628	80.00 - 80.50	46.50 - 47.00	3.599	.351	169.04	2.754	.184	178.50
629	80.50 - 81.00	25.00 - 25.50	2.688	.671	172.79	.000	.000	.00
630	80.50 - 81.00	25.50 - 26.00	2.906	.485	246.72	.000	.000	.00

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
631	80.50 - 81.00	26.00 - 26.50	2.960	.414	270.80	.000	.000	.00
632	80.50 - 81.00	26.50 - 27.00	2.960	.414	277.64	.000	.000	.00
633	80.50 - 81.00	27.00 - 27.50	2.478	.149	193.47	.000	.000	.00
634	80.50 - 81.00	27.50 - 28.00	2.478	.149	163.92	.000	.000	.00
635	80.50 - 81.00	28.00 - 28.50	2.779	.149	176.84	.000	.000	.00
636	80.50 - 81.00	28.50 - 29.00	3.527	.478	233.09	.000	.000	.00
637	80.50 - 81.00	29.00 - 29.50	3.555	.456	201.68	2.780	.175	273.87
638	80.50 - 81.00	29.50 - 30.00	3.587	.439	176.40	2.822	.122	234.87
639	80.50 - 81.00	30.00 - 30.50	3.593	.433	154.07	2.822	.122	204.35
640	80.50 - 81.00	30.50 - 31.00	3.626	.420	138.29	2.822	.122	173.94
641	80.50 - 81.00	31.00 - 31.50	3.663	.391	114.97	2.822	.122	143.55
642	80.50 - 81.00	31.50 - 32.00	3.702	.373	86.70	2.822	.122	112.99
643	80.50 - 81.00	32.00 - 32.50	3.739	.363	58.89	2.822	.122	81.89
644	80.50 - 81.00	32.50 - 33.00	3.756	.359	43.89	2.822	.122	50.30
645	80.50 - 81.00	33.00 - 33.50	3.880	.260	71.40	3.187	.085	38.05
646	80.50 - 81.00	33.50 - 34.00	3.912	.246	105.60	3.187	.085	76.78
647	80.50 - 81.00	34.00 - 34.50	3.906	.248	125.32	3.187	.085	109.19
648	80.50 - 81.00	34.50 - 35.00	3.917	.244	129.60	3.187	.085	129.85
649	80.50 - 81.00	35.00 - 35.50	3.933	.239	98.17	3.187	.085	134.82
650	80.50 - 81.00	35.50 - 36.00	3.938	.238	129.21	3.286	.137	138.49
651	80.50 - 81.00	36.00 - 36.50	3.969	.239	121.21	3.363	.173	124.94
652	80.50 - 81.00	36.50 - 37.00	4.049	.220	104.22	3.363	.173	89.53
653	80.50 - 81.00	37.00 - 37.50	4.010	.137	41.97	3.363	.173	47.36
654	80.50 - 81.00	37.50 - 38.00	4.007	.132	106.52	3.231	.173	75.20
655	80.50 - 81.00	38.00 - 38.50	4.025	.142	146.61	3.214	.194	102.92
656	80.50 - 81.00	38.50 - 39.00	4.072	.142	172.33	3.314	.205	137.26
657	80.50 - 81.00	39.00 - 39.50	4.072	.130	178.37	3.314	.205	146.34
658	80.50 - 81.00	39.50 - 40.00	4.061	.146	181.51	3.314	.205	151.80
659	80.50 - 81.00	40.00 - 40.50	4.040	.157	180.62	3.314	.205	164.37
660	80.50 - 81.00	40.50 - 41.00	4.016	.163	169.89	3.314	.205	182.29
661	80.50 - 81.00	41.00 - 41.50	4.010	.178	153.19	3.314	.205	198.29
662	80.50 - 81.00	41.50 - 42.00	3.930	.155	134.70	3.040	.318	169.19
663	80.50 - 81.00	42.00 - 42.50	3.887	.168	74.17	3.072	.282	175.14
664	80.50 - 81.00	42.50 - 43.00	3.922	.205	153.26	3.072	.282	178.89
665	80.50 - 81.00	43.00 - 43.50	3.921	.219	182.21	3.098	.255	191.31

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
666	80.50 - 81.00	43.50 - 44.00	3.895	.232	204.60	3.098	.255	206.10
667	80.50 - 81.00	44.00 - 44.50	3.867	.235	227.18	2.954	.225	200.92
668	80.50 - 81.00	44.50 - 45.00	3.796	.243	238.53	2.722	.187	170.45
669	80.50 - 81.00	45.00 - 45.50	3.631	.200	223.30	2.722	.187	179.33
670	80.50 - 81.00	45.50 - 46.00	3.618	.220	226.81	2.722	.187	186.28
671	80.50 - 81.00	46.00 - 46.50	3.595	.257	219.54	2.722	.187	193.56
672	80.50 - 81.00	46.50 - 47.00	3.472	.308	196.42	2.722	.187	203.60
673	81.00 - 81.50	25.00 - 25.50	2.688	.671	175.69	.000	.000	.00
674	81.00 - 81.50	25.50 - 26.00	2.906	.485	247.58	.000	.000	.00
675	81.00 - 81.50	26.00 - 26.50	2.960	.414	269.33	.000	.000	.00
676	81.00 - 81.50	26.50 - 27.00	2.960	.414	273.57	.000	.000	.00
677	81.00 - 81.50	27.00 - 27.50	2.478	.149	183.46	.000	.000	.00
678	81.00 - 81.50	27.50 - 28.00	2.478	.149	151.93	.000	.000	.00
679	81.00 - 81.50	28.00 - 28.50	2.779	.149	161.76	.000	.000	.00
680	81.00 - 81.50	28.50 - 29.00	3.527	.478	222.21	.000	.000	.00
681	81.00 - 81.50	29.00 - 29.50	3.555	.456	185.21	2.780	.175	273.44
682	81.00 - 81.50	29.50 - 30.00	3.587	.439	155.43	2.822	.122	234.19
683	81.00 - 81.50	30.00 - 30.50	3.593	.433	133.24	2.822	.122	203.94
684	81.00 - 81.50	30.50 - 31.00	3.626	.420	134.54	2.822	.122	174.05
685	81.00 - 81.50	31.00 - 31.50	3.663	.391	119.13	2.822	.122	144.69
686	81.00 - 81.50	31.50 - 32.00	3.702	.373	91.82	2.822	.122	116.11
687	81.00 - 81.50	32.00 - 32.50	3.739	.363	47.75	2.822	.122	88.79
688	81.00 - 81.50	32.50 - 33.00	3.756	.359	71.51	2.822	.122	64.03
689	81.00 - 81.50	33.00 - 33.50	3.880	.260	96.79	3.187	.085	77.78
690	81.00 - 81.50	33.50 - 34.00	3.912	.246	116.34	3.187	.085	80.48
691	81.00 - 81.50	34.00 - 34.50	3.917	.244	123.42	3.187	.085	105.76
692	81.00 - 81.50	34.50 - 35.00	3.928	.242	116.01	3.187	.085	127.07
693	81.00 - 81.50	35.00 - 35.50	3.943	.237	121.12	3.187	.085	130.89
694	81.00 - 81.50	35.50 - 36.00	3.948	.236	122.04	3.286	.137	131.63
695	81.00 - 81.50	36.00 - 36.50	3.977	.239	92.52	3.363	.173	113.69
696	81.00 - 81.50	36.50 - 37.00	4.051	.226	90.08	3.363	.173	73.75
697	81.00 - 81.50	37.00 - 37.50	4.013	.152	66.22	3.363	.173	34.92
698	81.00 - 81.50	37.50 - 38.00	4.010	.147	114.68	3.231	.173	61.52
699	81.00 - 81.50	38.00 - 38.50	4.017	.146	145.89	3.214	.194	92.33
700	81.00 - 81.50	38.50 - 39.00	4.054	.143	163.34	3.314	.205	126.12

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
701	81.00 - 81.50	39.00 - 39.50	4.054	.130	162.08	3.314	.205	127.49
702	81.00 - 81.50	39.50 - 40.00	4.037	.149	161.89	3.314	.205	124.19
703	81.00 - 81.50	40.00 - 40.50	4.014	.162	162.88	3.314	.205	142.62
704	81.00 - 81.50	40.50 - 41.00	3.986	.173	148.87	3.314	.205	172.43
705	81.00 - 81.50	41.00 - 41.50	3.979	.189	97.47	3.314	.205	198.31
706	81.00 - 81.50	41.50 - 42.00	3.896	.159	110.71	3.040	.318	178.92
707	81.00 - 81.50	42.00 - 42.50	3.847	.179	114.05	3.072	.282	191.62
708	81.00 - 81.50	42.50 - 43.00	3.882	.224	153.88	3.072	.282	199.46
709	81.00 - 81.50	43.00 - 43.50	3.894	.229	186.22	3.098	.255	212.70
710	81.00 - 81.50	43.50 - 44.00	3.866	.244	208.50	3.098	.255	226.18
711	81.00 - 81.50	44.00 - 44.50	3.835	.249	228.44	2.954	.225	221.31
712	81.00 - 81.50	44.50 - 45.00	3.761	.255	240.13	2.722	.187	186.81
713	81.00 - 81.50	45.00 - 45.50	3.577	.216	225.64	2.722	.187	195.60
714	81.00 - 81.50	45.50 - 46.00	3.562	.237	235.55	2.722	.187	203.57
715	81.00 - 81.50	46.00 - 46.50	3.535	.278	239.37	2.722	.187	212.04
716	81.00 - 81.50	46.50 - 47.00	3.383	.346	220.71	2.722	.187	222.55
717	81.50 - 82.00	25.00 - 25.50	2.688	.671	184.13	.000	.000	.00
718	81.50 - 82.00	25.50 - 26.00	2.906	.485	253.14	.000	.000	.00
719	81.50 - 82.00	26.00 - 26.50	2.960	.414	271.69	.000	.000	.00
720	81.50 - 82.00	26.50 - 27.00	2.960	.414	273.17	.000	.000	.00
721	81.50 - 82.00	27.00 - 27.50	2.478	.149	177.51	.000	.000	.00
722	81.50 - 82.00	27.50 - 28.00	2.478	.149	144.57	.000	.000	.00
723	81.50 - 82.00	28.00 - 28.50	2.779	.149	151.74	.000	.000	.00
724	81.50 - 82.00	28.50 - 29.00	3.527	.478	212.70	.000	.000	.00
725	81.50 - 82.00	29.00 - 29.50	3.555	.456	162.36	2.780	.175	275.17
726	81.50 - 82.00	29.50 - 30.00	3.620	.426	125.57	2.822	.122	235.74
727	81.50 - 82.00	30.00 - 30.50	3.652	.413	82.58	2.822	.122	205.88
728	81.50 - 82.00	30.50 - 31.00	3.673	.410	139.62	2.822	.122	176.60
729	81.50 - 82.00	31.00 - 31.50	3.708	.382	135.10	2.822	.122	148.21
730	81.50 - 82.00	31.50 - 32.00	3.740	.370	113.72	2.822	.122	121.30
731	81.50 - 82.00	32.00 - 32.50	3.771	.363	94.87	2.822	.122	96.89
732	81.50 - 82.00	32.50 - 33.00	3.787	.359	98.03	2.822	.122	76.53
733	81.50 - 82.00	33.00 - 33.50	3.905	.258	119.13	3.187	.085	93.15
734	81.50 - 82.00	33.50 - 34.00	3.934	.246	126.47	3.187	.085	44.93
735	81.50 - 82.00	34.00 - 34.50	3.939	.245	121.89	3.187	.085	102.01

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
736	81.50 - 82.00	34.50 - 35.00	3.949	.242	73.77	3.187	.085	127.66
737	81.50 - 82.00	35.00 - 35.50	3.962	.239	115.36	3.187	.085	130.65
738	81.50 - 82.00	35.50 - 36.00	3.967	.238	114.94	3.286	.137	129.89
739	81.50 - 82.00	36.00 - 36.50	3.992	.244	113.73	3.286	.137	99.63
740	81.50 - 82.00	36.50 - 37.00	4.051	.225	112.37	3.363	.173	67.26
741	81.50 - 82.00	37.00 - 37.50	4.013	.151	111.40	3.363	.173	25.78
742	81.50 - 82.00	37.50 - 38.00	4.011	.147	131.40	3.231	.173	55.92
743	81.50 - 82.00	38.00 - 38.50	4.017	.146	147.66	3.214	.194	88.45
744	81.50 - 82.00	38.50 - 39.00	4.054	.142	152.09	3.314	.205	119.21
745	81.50 - 82.00	39.00 - 39.50	4.054	.129	132.98	3.314	.205	105.00
746	81.50 - 82.00	39.50 - 40.00	4.038	.148	132.55	3.314	.205	79.20
747	81.50 - 82.00	40.00 - 40.50	4.014	.161	146.33	3.314	.205	114.56
748	81.50 - 82.00	40.50 - 41.00	3.987	.172	139.40	3.314	.205	162.21
749	81.50 - 82.00	41.00 - 41.50	3.980	.188	92.68	3.314	.205	198.14
750	81.50 - 82.00	41.50 - 42.00	3.897	.158	68.24	3.040	.318	187.04
751	81.50 - 82.00	42.00 - 42.50	3.848	.177	119.45	3.072	.282	205.75
752	81.50 - 82.00	42.50 - 43.00	3.883	.222	158.61	3.072	.282	217.37
753	81.50 - 82.00	43.00 - 43.50	3.858	.240	182.38	3.098	.255	231.97
754	81.50 - 82.00	43.50 - 44.00	3.821	.265	202.92	3.098	.255	245.20
755	81.50 - 82.00	44.00 - 44.50	3.806	.275	226.26	2.954	.225	242.42
756	81.50 - 82.00	44.50 - 45.00	3.726	.285	238.57	2.722	.187	204.21
757	81.50 - 82.00	45.00 - 45.50	3.555	.233	232.60	2.722	.187	212.64
758	81.50 - 82.00	45.50 - 46.00	3.538	.257	247.81	2.722	.187	221.04
759	81.50 - 82.00	46.00 - 46.50	3.507	.303	259.59	2.722	.187	230.16
760	81.50 - 82.00	46.50 - 47.00	3.332	.390	245.10	2.722	.187	240.99
761	82.00 - 82.50	25.00 - 25.50	2.688	.671	197.40	.000	.000	.00
762	82.00 - 82.50	25.50 - 26.00	2.906	.485	262.86	.000	.000	.00
763	82.00 - 82.50	26.00 - 26.50	2.960	.414	277.71	.000	.000	.00
764	82.00 - 82.50	26.50 - 27.00	2.960	.414	276.62	.000	.000	.00
765	82.00 - 82.50	27.00 - 27.50	2.478	.149	176.11	.000	.000	.00
766	82.00 - 82.50	27.50 - 28.00	2.478	.149	142.70	.000	.000	.00
767	82.00 - 82.50	28.00 - 28.50	2.779	.149	149.21	.000	.000	.00
768	82.00 - 82.50	28.50 - 29.00	3.527	.478	211.32	.000	.000	.00
769	82.00 - 82.50	29.00 - 29.50	3.555	.456	146.77	2.780	.175	278.94
770	82.00 - 82.50	29.50 - 30.00	3.620	.426	60.32	2.822	.122	239.38

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
771	82.00 - 82.50	30.00 - 30.50	3.652	.413	128.51	2.822	.122	209.92
772	82.00 - 82.50	30.50 - 31.00	3.673	.410	152.02	2.822	.122	181.08
773	82.00 - 82.50	31.00 - 31.50	3.708	.382	148.87	2.822	.122	153.14
774	82.00 - 82.50	31.50 - 32.00	3.740	.370	134.68	2.822	.122	126.53
775	82.00 - 82.50	32.00 - 32.50	3.771	.363	123.16	2.822	.122	102.00
776	82.00 - 82.50	32.50 - 33.00	3.787	.359	116.90	2.822	.122	81.06
777	82.00 - 82.50	33.00 - 33.50	3.905	.258	127.92	3.187	.085	103.07
778	82.00 - 82.50	33.50 - 34.00	3.934	.246	121.60	3.187	.085	92.16
779	82.00 - 82.50	34.00 - 34.50	3.939	.245	123.35	3.187	.085	114.13
780	82.00 - 82.50	34.50 - 35.00	3.950	.240	111.16	3.187	.085	132.76
781	82.00 - 82.50	35.00 - 35.50	3.964	.238	102.23	3.187	.085	134.25
782	82.00 - 82.50	35.50 - 36.00	3.968	.237	82.93	3.286	.137	133.73
783	82.00 - 82.50	36.00 - 36.50	3.994	.243	110.24	3.286	.137	104.58
784	82.00 - 82.50	36.50 - 37.00	4.060	.225	85.70	3.286	.137	66.67
785	82.00 - 82.50	37.00 - 37.50	4.028	.155	129.85	3.286	.137	28.13
786	82.00 - 82.50	37.50 - 38.00	4.025	.151	144.91	3.123	.122	53.06
787	82.00 - 82.50	38.00 - 38.50	4.031	.150	150.80	3.104	.146	79.98
788	82.00 - 82.50	38.50 - 39.00	4.069	.143	143.19	3.231	.173	108.00
789	82.00 - 82.50	39.00 - 39.50	4.069	.130	79.72	3.231	.173	82.71
790	82.00 - 82.50	39.50 - 40.00	4.053	.148	82.45	3.231	.173	27.71
791	82.00 - 82.50	40.00 - 40.50	4.031	.159	134.42	3.231	.173	88.73
792	82.00 - 82.50	40.50 - 41.00	4.005	.168	136.92	3.231	.173	146.62
793	82.00 - 82.50	41.00 - 41.50	3.987	.180	122.66	3.231	.173	188.62
794	82.00 - 82.50	41.50 - 42.00	3.904	.150	82.40	2.881	.298	171.66
795	82.00 - 82.50	42.00 - 42.50	3.857	.167	120.40	2.922	.255	195.51
796	82.00 - 82.50	42.50 - 43.00	3.892	.211	157.88	2.922	.255	209.35
797	82.00 - 82.50	43.00 - 43.50	3.880	.237	184.21	3.072	.282	247.86
798	82.00 - 82.50	43.50 - 44.00	3.822	.263	200.30	3.072	.282	262.88
799	82.00 - 82.50	44.00 - 44.50	3.807	.273	224.03	2.922	.255	266.49
800	82.00 - 82.50	44.50 - 45.00	3.733	.276	239.96	2.680	.206	226.95
801	82.00 - 82.50	45.00 - 45.50	3.562	.223	238.08	2.680	.206	238.10
802	82.00 - 82.50	45.50 - 46.00	3.547	.244	258.06	2.680	.206	250.32
803	82.00 - 82.50	46.00 - 46.50	3.518	.286	276.67	2.680	.206	263.98
804	82.00 - 82.50	46.50 - 47.00	3.350	.367	273.13	2.680	.206	279.73
805	82.50 - 83.00	25.00 - 25.50	2.688	.671	214.60	.000	.000	.00

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
806	82.50 - 83.00	25.50 - 26.00	2.906	.485	276.09	.000	.000	.00
807	82.50 - 83.00	26.00 - 26.50	2.960	.414	287.17	.000	.000	.00
808	82.50 - 83.00	26.50 - 27.00	2.960	.414	284.00	.000	.000	.00
809	82.50 - 83.00	27.00 - 27.50	2.478	.149	179.44	.000	.000	.00
810	82.50 - 83.00	27.50 - 28.00	2.478	.149	146.70	.000	.000	.00
811	82.50 - 83.00	28.00 - 28.50	2.779	.149	155.54	.000	.000	.00
812	82.50 - 83.00	28.50 - 29.00	3.527	.478	224.61	.000	.000	.00
813	82.50 - 83.00	29.00 - 29.50	3.555	.456	173.45	2.780	.175	284.68
814	82.50 - 83.00	29.50 - 30.00	3.620	.426	141.10	2.822	.122	245.02
815	82.50 - 83.00	30.00 - 30.50	3.652	.413	160.79	2.822	.122	215.94
816	82.50 - 83.00	30.50 - 31.00	3.673	.410	171.15	2.822	.122	187.36
817	82.50 - 83.00	31.00 - 31.50	3.708	.382	164.93	2.822	.122	159.30
818	82.50 - 83.00	31.50 - 32.00	3.740	.370	152.79	2.822	.122	131.58
819	82.50 - 83.00	32.00 - 32.50	3.771	.363	141.10	2.822	.122	103.43
820	82.50 - 83.00	32.50 - 33.00	3.787	.359	127.27	2.822	.122	73.75
821	82.50 - 83.00	33.00 - 33.50	3.905	.258	124.43	3.187	.085	85.63
822	82.50 - 83.00	33.50 - 34.00	3.930	.250	77.71	3.187	.085	103.99
823	82.50 - 83.00	34.00 - 34.50	3.936	.248	122.90	3.187	.085	126.96
824	82.50 - 83.00	34.50 - 35.00	3.958	.243	116.35	3.187	.085	140.99
825	82.50 - 83.00	35.00 - 35.50	3.971	.241	65.47	3.187	.085	141.50
826	82.50 - 83.00	35.50 - 36.00	3.975	.240	61.55	3.286	.137	142.92
827	82.50 - 83.00	36.00 - 36.50	3.999	.247	108.24	3.286	.137	117.80
828	82.50 - 83.00	36.50 - 37.00	4.090	.220	126.03	3.286	.137	87.46
829	82.50 - 83.00	37.00 - 37.50	4.075	.159	143.93	3.286	.137	67.13
830	82.50 - 83.00	37.50 - 38.00	4.073	.155	155.08	3.123	.122	70.00
831	82.50 - 83.00	38.00 - 38.50	4.078	.155	155.81	3.104	.146	90.21
832	82.50 - 83.00	38.50 - 39.00	4.116	.135	148.33	3.231	.173	116.30
833	82.50 - 83.00	39.00 - 39.50	4.115	.125	102.39	3.231	.173	97.70
834	82.50 - 83.00	39.50 - 40.00	4.102	.139	124.33	3.231	.173	71.95
835	82.50 - 83.00	40.00 - 40.50	4.082	.148	132.64	3.231	.173	105.95
836	82.50 - 83.00	40.50 - 41.00	4.060	.153	133.65	3.231	.173	155.08
837	82.50 - 83.00	41.00 - 41.50	4.048	.156	134.76	3.231	.173	195.80
838	82.50 - 83.00	41.50 - 42.00	3.971	.143	120.62	2.881	.298	180.64
839	82.50 - 83.00	42.00 - 42.50	3.918	.151	117.27	2.922	.255	207.38
840	82.50 - 83.00	42.50 - 43.00	3.938	.188	156.38	2.922	.255	223.71

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
841	82.50 - 83.00	43.00 - 43.50	3.931	.272	189.41	2.922	.255	238.14
842	82.50 - 83.00	43.50 - 44.00	3.877	.301	203.27	2.922	.255	252.43
843	82.50 - 83.00	44.00 - 44.50	3.863	.311	228.94	2.680	.206	237.90
844	82.50 - 83.00	44.50 - 45.00	3.795	.319	248.74	2.680	.206	246.86
845	82.50 - 83.00	45.00 - 45.50	3.656	.291	255.61	2.680	.206	257.43
846	82.50 - 83.00	45.50 - 46.00	3.641	.310	273.24	2.680	.206	269.41
847	82.50 - 83.00	46.00 - 46.50	3.614	.348	288.28	2.680	.206	283.00
848	82.50 - 83.00	46.50 - 47.00	3.470	.427	282.02	2.680	.206	298.55
849	83.00 - 83.50	25.00 - 25.50	2.688	.671	234.87	.000	.000	.00
850	83.00 - 83.50	25.50 - 26.00	2.906	.485	292.26	.000	.000	.00
851	83.00 - 83.50	26.00 - 26.50	2.960	.414	299.79	.000	.000	.00
852	83.00 - 83.50	26.50 - 27.00	2.960	.414	295.20	.000	.000	.00
853	83.00 - 83.50	27.00 - 27.50	2.478	.149	187.31	.000	.000	.00
854	83.00 - 83.50	27.50 - 28.00	2.478	.149	156.21	.000	.000	.00
855	83.00 - 83.50	28.00 - 28.50	2.779	.149	169.71	.000	.000	.00
856	83.00 - 83.50	28.50 - 29.00	3.535	.468	248.54	.000	.000	.00
857	83.00 - 83.50	29.00 - 29.50	3.562	.449	213.22	2.780	.175	292.33
858	83.00 - 83.50	29.50 - 30.00	3.626	.420	196.53	2.822	.122	252.62
859	83.00 - 83.50	30.00 - 30.50	3.652	.413	193.98	2.822	.122	223.98
860	83.00 - 83.50	30.50 - 31.00	3.673	.410	191.70	2.822	.122	195.65
861	83.00 - 83.50	31.00 - 31.50	3.708	.382	181.34	2.822	.122	167.40
862	83.00 - 83.50	31.50 - 32.00	3.740	.370	168.36	2.822	.122	138.40
863	83.00 - 83.50	32.00 - 32.50	3.771	.363	154.46	2.822	.122	106.37
864	83.00 - 83.50	32.50 - 33.00	3.787	.359	133.11	2.822	.122	65.69
865	83.00 - 83.50	33.00 - 33.50	3.905	.258	96.50	3.187	.085	35.47
866	83.00 - 83.50	33.50 - 34.00	3.932	.252	114.81	3.187	.085	99.15
867	83.00 - 83.50	34.00 - 34.50	3.947	.248	128.38	3.187	.085	136.57
868	83.00 - 83.50	34.50 - 35.00	3.970	.243	124.27	3.187	.085	151.31
869	83.00 - 83.50	35.00 - 35.50	3.990	.243	105.63	3.187	.085	152.02
870	83.00 - 83.50	35.50 - 36.00	3.994	.242	97.24	3.286	.137	156.50
871	83.00 - 83.50	36.00 - 36.50	4.016	.250	104.32	3.286	.137	136.91
872	83.00 - 83.50	36.50 - 37.00	4.088	.221	123.23	3.377	.152	127.09
873	83.00 - 83.50	37.00 - 37.50	4.071	.163	144.72	3.377	.152	116.30
874	83.00 - 83.50	37.50 - 38.00	4.070	.159	156.46	3.278	.171	112.53
875	83.00 - 83.50	38.00 - 38.50	4.075	.159	154.36	3.266	.190	126.76

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
876	83.00 - 83.50	38.50 - 39.00	4.112	.140	146.99	3.341	.184	146.20
877	83.00 - 83.50	39.00 - 39.50	4.112	.130	135.89	3.341	.184	139.68
878	83.00 - 83.50	39.50 - 40.00	4.098	.145	127.79	3.341	.184	133.63
879	83.00 - 83.50	40.00 - 40.50	4.078	.154	115.06	3.341	.184	154.35
880	83.00 - 83.50	40.50 - 41.00	4.056	.161	111.16	3.341	.184	190.57
881	83.00 - 83.50	41.00 - 41.50	4.044	.164	123.47	3.341	.184	226.11
882	83.00 - 83.50	41.50 - 42.00	3.964	.153	119.96	3.135	.321	243.85
883	83.00 - 83.50	42.00 - 42.50	3.915	.155	70.00	2.881	.298	216.21
884	83.00 - 83.50	42.50 - 43.00	3.935	.193	147.67	2.881	.298	235.96
885	83.00 - 83.50	43.00 - 43.50	3.946	.258	183.49	2.922	.255	254.05
886	83.00 - 83.50	43.50 - 44.00	3.894	.285	179.39	3.314	.277	324.36
887	83.00 - 83.50	44.00 - 44.50	3.882	.294	219.44	3.152	.366	286.24
888	83.00 - 83.50	44.50 - 45.00	3.816	.300	247.81	3.152	.366	277.74
889	83.00 - 83.50	45.00 - 45.50	3.683	.269	258.06	3.152	.366	269.50
890	83.00 - 83.50	45.50 - 46.00	3.670	.286	276.09	3.152	.366	261.79
891	83.00 - 83.50	46.00 - 46.50	3.624	.334	287.54	3.152	.366	255.21
892	83.00 - 83.50	46.50 - 47.00	3.485	.409	281.49	3.152	.366	250.48
893	83.00 - 83.50	47.00 - 47.50	3.380	.371	264.06	3.080	.559	245.82
894	83.00 - 83.50	47.50 - 48.00	3.267	.468	247.39	3.080	.559	244.55
895	83.50 - 84.00	25.00 - 25.50	2.688	.671	257.48	.000	.000	.00
896	83.50 - 84.00	25.50 - 26.00	2.906	.485	310.88	.000	.000	.00
897	83.50 - 84.00	26.00 - 26.50	2.960	.414	315.29	.000	.000	.00
898	83.50 - 84.00	26.50 - 27.00	2.960	.414	309.92	.000	.000	.00
899	83.50 - 84.00	27.00 - 27.50	2.478	.149	199.19	.000	.000	.00
900	83.50 - 84.00	27.50 - 28.00	2.478	.149	170.33	.000	.000	.00
901	83.50 - 84.00	28.00 - 28.50	2.779	.149	189.26	.000	.000	.00
902	83.50 - 84.00	28.50 - 29.00	3.543	.460	274.29	.000	.000	.00
903	83.50 - 84.00	29.00 - 29.50	3.568	.442	245.86	2.780	.175	301.87
904	83.50 - 84.00	29.50 - 30.00	3.631	.415	230.16	2.822	.122	262.20
905	83.50 - 84.00	30.00 - 30.50	3.657	.408	220.70	2.822	.122	234.14
906	83.50 - 84.00	30.50 - 31.00	3.678	.405	211.93	2.822	.122	206.32
907	83.50 - 84.00	31.00 - 31.50	3.711	.379	197.04	2.822	.122	178.39
908	83.50 - 84.00	31.50 - 32.00	3.743	.368	182.38	2.822	.122	149.53
909	83.50 - 84.00	32.00 - 32.50	3.773	.362	166.62	2.822	.122	118.02
910	83.50 - 84.00	32.50 - 33.00	3.789	.358	145.47	2.822	.122	82.60

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
911	83.50 - 84.00	33.00 - 33.50	3.908	.254	135.53	3.187	.085	93.95
912	83.50 - 84.00	33.50 - 34.00	3.920	.249	79.05	3.320	.132	142.20
913	83.50 - 84.00	34.00 - 34.50	3.935	.245	129.89	3.320	.132	173.23
914	83.50 - 84.00	34.50 - 35.00	3.959	.239	126.94	3.320	.132	185.38
915	83.50 - 84.00	35.00 - 35.50	3.981	.238	108.64	3.320	.132	184.84
916	83.50 - 84.00	35.50 - 36.00	3.985	.238	82.44	3.377	.152	182.67
917	83.50 - 84.00	36.00 - 36.50	4.008	.245	69.17	3.377	.152	168.05
918	83.50 - 84.00	36.50 - 37.00	4.076	.225	84.56	3.386	.139	154.33
919	83.50 - 84.00	37.00 - 37.50	4.052	.167	139.39	3.386	.139	147.92
920	83.50 - 84.00	37.50 - 38.00	4.055	.163	154.69	3.290	.154	138.54
921	83.50 - 84.00	38.00 - 38.50	4.061	.163	150.33	3.278	.171	146.12
922	83.50 - 84.00	38.50 - 39.00	4.051	.154	105.58	3.278	.171	152.67
923	83.50 - 84.00	39.00 - 39.50	4.050	.144	128.73	3.278	.171	154.53
924	83.50 - 84.00	39.50 - 40.00	4.036	.155	106.90	3.278	.171	158.53
925	83.50 - 84.00	40.00 - 40.50	4.015	.161	75.65	3.278	.171	175.00
926	83.50 - 84.00	40.50 - 41.00	3.990	.163	67.37	3.278	.171	203.07
927	83.50 - 84.00	41.00 - 41.50	3.972	.172	94.48	3.278	.171	236.17
928	83.50 - 84.00	41.50 - 42.00	3.860	.204	104.17	2.972	.411	244.28
929	83.50 - 84.00	42.00 - 42.50	3.821	.187	103.33	2.521	.367	190.23
930	83.50 - 84.00	42.50 - 43.00	3.864	.180	140.94	2.521	.367	221.99
931	83.50 - 84.00	43.00 - 43.50	3.957	.266	180.26	2.922	.255	265.93
932	83.50 - 84.00	43.50 - 44.00	3.911	.286	113.38	3.314	.277	327.08
933	83.50 - 84.00	44.00 - 44.50	3.899	.295	212.62	3.152	.366	286.90
934	83.50 - 84.00	44.50 - 45.00	3.838	.300	249.62	3.152	.366	277.05
935	83.50 - 84.00	45.00 - 45.50	3.714	.267	262.93	3.152	.366	266.99
936	83.50 - 84.00	45.50 - 46.00	3.702	.285	280.30	3.152	.366	257.14
937	83.50 - 84.00	46.00 - 46.50	3.658	.332	290.76	3.148	.361	252.71
938	83.50 - 84.00	46.50 - 47.00	3.534	.401	287.27	3.148	.361	244.88
939	83.50 - 84.00	47.00 - 47.50	3.380	.371	256.09	3.074	.553	234.73
940	83.50 - 84.00	47.50 - 48.00	3.267	.468	237.51	3.074	.553	232.18
941	84.00 - 84.50	28.00 - 28.50	2.779	.149	211.94	.000	.000	.00
942	84.00 - 84.50	28.50 - 29.00	3.543	.460	298.83	.000	.000	.00
943	84.00 - 84.50	29.00 - 29.50	3.568	.442	273.22	2.780	.175	313.28
944	84.00 - 84.50	29.50 - 30.00	3.631	.415	255.54	2.822	.122	273.74
945	84.00 - 84.50	30.00 - 30.50	3.657	.408	242.79	2.822	.122	246.49

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
946	84.00 - 84.50	30.50 - 31.00	3.678	.405	230.77	2.822	.122	219.58
947	84.00 - 84.50	31.00 - 31.50	3.711	.379	212.30	2.822	.122	192.78
948	84.00 - 84.50	31.50 - 32.00	3.743	.368	195.77	2.822	.122	165.77
949	84.00 - 84.50	32.00 - 32.50	3.773	.362	178.99	2.822	.122	138.47
950	84.00 - 84.50	32.50 - 33.00	3.793	.356	159.76	2.822	.122	113.46
951	84.00 - 84.50	33.00 - 33.50	3.912	.250	158.99	3.201	.066	150.68
952	84.00 - 84.50	33.50 - 34.00	3.923	.246	137.98	3.329	.118	179.84
953	84.00 - 84.50	34.00 - 34.50	3.939	.241	140.89	3.329	.118	193.13
954	84.00 - 84.50	34.50 - 35.00	3.962	.236	127.64	3.329	.118	198.89
955	84.00 - 84.50	35.00 - 35.50	3.983	.236	76.87	3.329	.118	196.75
956	84.00 - 84.50	35.50 - 36.00	3.987	.236	81.49	3.386	.139	196.21
957	84.00 - 84.50	36.00 - 36.50	4.011	.243	66.57	3.386	.139	185.26
958	84.00 - 84.50	36.50 - 37.00	4.134	.220	124.71	3.592	.251	209.33
959	84.00 - 84.50	37.00 - 37.50	4.150	.158	157.52	3.592	.251	204.30
960	84.00 - 84.50	37.50 - 38.00	4.153	.154	167.40	3.530	.274	195.43
961	84.00 - 84.50	38.00 - 38.50	4.158	.153	164.33	3.521	.285	199.99
962	84.00 - 84.50	38.50 - 39.00	4.158	.153	153.58	3.521	.285	206.58
963	84.00 - 84.50	39.00 - 39.50	4.154	.144	145.49	3.521	.285	213.46
964	84.00 - 84.50	39.50 - 40.00	4.140	.159	111.40	3.521	.285	223.31
965	84.00 - 84.50	40.00 - 40.50	4.123	.166	44.51	3.521	.285	240.12
966	84.00 - 84.50	40.50 - 41.00	4.099	.177	34.50	3.521	.285	264.02
967	84.00 - 84.50	41.00 - 41.50	4.052	.187	92.57	3.521	.285	292.16
968	84.00 - 84.50	41.50 - 42.00	3.849	.199	102.45	3.210	.404	287.70
969	84.00 - 84.50	42.00 - 42.50	3.833	.197	116.18	2.621	.255	204.67
970	84.00 - 84.50	42.50 - 43.00	3.876	.187	147.33	2.621	.255	229.57
971	84.00 - 84.50	43.00 - 43.50	3.909	.248	176.82	2.621	.255	255.12
972	84.00 - 84.50	43.50 - 44.00	3.864	.261	173.18	3.148	.361	299.53
973	84.00 - 84.50	44.00 - 44.50	3.852	.270	211.99	3.080	.559	302.47
974	84.00 - 84.50	44.50 - 45.00	3.787	.270	239.83	3.080	.559	282.07
975	84.00 - 84.50	45.00 - 45.50	3.641	.218	244.52	3.080	.559	262.52
976	84.00 - 84.50	45.50 - 46.00	3.628	.239	258.05	3.080	.559	244.59
977	84.00 - 84.50	46.00 - 46.50	3.580	.292	264.06	3.074	.553	233.23
978	84.00 - 84.50	46.50 - 47.00	3.440	.364	253.00	3.074	.553	220.10
979	84.00 - 84.50	47.00 - 47.50	3.380	.371	242.91	3.074	.553	211.84
980	84.00 - 84.50	47.50 - 48.00	3.267	.468	223.30	3.074	.553	209.01

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
981	84.00 - 84.50	48.00 - 48.50	3.241	.498	232.77	3.074	.553	211.84
982	84.00 - 84.50	48.50 - 49.00	3.241	.498	249.15	3.074	.553	220.10
983	84.00 - 84.50	49.00 - 49.50	3.241	.498	269.80	3.074	.553	233.23
984	84.00 - 84.50	49.50 - 50.00	3.206	.541	288.75	3.074	.553	250.46
985	84.50 - 85.00	28.00 - 28.50	2.828	.101	233.91	.000	.000	.00
986	84.50 - 85.00	28.50 - 29.00	3.549	.453	316.77	.000	.000	.00
987	84.50 - 85.00	29.00 - 29.50	3.573	.437	293.04	2.780	.175	326.50
988	84.50 - 85.00	29.50 - 30.00	3.635	.410	273.72	2.822	.122	287.18
989	84.50 - 85.00	30.00 - 30.50	3.661	.403	259.50	2.822	.122	260.98
990	84.50 - 85.00	30.50 - 31.00	3.682	.401	246.27	2.822	.122	235.35
991	84.50 - 85.00	31.00 - 31.50	3.717	.374	224.68	2.822	.122	210.32
992	84.50 - 85.00	31.50 - 32.00	3.747	.365	206.52	2.822	.122	186.08
993	84.50 - 85.00	32.00 - 32.50	3.781	.357	188.73	2.822	.122	163.56
994	84.50 - 85.00	32.50 - 33.00	3.834	.355	173.65	2.822	.122	145.72
995	84.50 - 85.00	33.00 - 33.50	4.019	.219	190.07	3.329	.118	213.83
996	84.50 - 85.00	33.50 - 34.00	4.027	.216	173.67	3.552	.256	256.83
997	84.50 - 85.00	34.00 - 34.50	4.040	.211	162.28	3.552	.256	255.59
998	84.50 - 85.00	34.50 - 35.00	4.057	.208	143.94	3.552	.256	251.75
999	84.50 - 85.00	35.00 - 35.50	4.073	.210	119.22	3.552	.256	244.13
1000	84.50 - 85.00	35.50 - 36.00	4.077	.209	97.08	3.592	.251	239.18
1001	84.50 - 85.00	36.00 - 36.50	4.095	.217	116.39	3.592	.251	228.19
1002	84.50 - 85.00	36.50 - 37.00	4.750	.683	269.54	3.796	.238	238.38
1003	84.50 - 85.00	37.00 - 37.50	4.758	.698	294.96	3.796	.238	235.61
1004	84.50 - 85.00	37.50 - 38.00	4.759	.697	297.91	3.760	.250	231.55
1005	84.50 - 85.00	38.00 - 38.50	4.761	.695	295.01	3.755	.257	236.70
1006	84.50 - 85.00	38.50 - 39.00	4.757	.697	295.76	3.755	.257	245.07
1007	84.50 - 85.00	39.00 - 39.50	4.755	.698	290.83	3.755	.257	256.05
1008	84.50 - 85.00	39.50 - 40.00	4.750	.703	257.85	3.755	.257	270.15
1009	84.50 - 85.00	40.00 - 40.50	4.738	.713	198.38	3.687	.244	273.72
1010	84.50 - 85.00	40.50 - 41.00	4.717	.733	181.84	3.659	.245	290.91
1011	84.50 - 85.00	41.00 - 41.50	4.063	.185	107.09	3.564	.278	301.46
1012	84.50 - 85.00	41.50 - 42.00	3.855	.202	103.72	3.297	.376	302.02
1013	84.50 - 85.00	42.00 - 42.50	3.839	.200	105.50	2.881	.298	261.28
1014	84.50 - 85.00	42.50 - 43.00	3.792	.200	127.33	2.621	.255	233.72
1015	84.50 - 85.00	43.00 - 43.50	3.937	.243	187.92	2.621	.255	257.19

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1C16	84.50 - 85.00	43.50 - 44.00	3.872	.271	201.01	3.148	.361	291.78
1C17	84.50 - 85.00	44.00 - 44.50	3.859	.280	225.75	3.080	.559	287.95
1C18	84.50 - 85.00	44.50 - 45.00	3.775	.278	240.27	3.080	.559	266.63
1C19	84.50 - 85.00	45.00 - 45.50	3.626	.228	239.55	3.080	.559	245.83
1C20	84.50 - 85.00	45.50 - 46.00	3.612	.249	248.47	3.080	.559	226.41
1C21	84.50 - 85.00	46.00 - 46.50	3.561	.306	249.16	3.074	.553	212.72
1C22	84.50 - 85.00	46.50 - 47.00	3.404	.393	227.61	3.074	.553	198.24
1C23	84.50 - 85.00	47.00 - 47.50	3.338	.404	214.91	3.074	.553	189.02
1C24	84.50 - 85.00	47.50 - 48.00	3.267	.468	205.45	3.074	.553	185.84
1C25	84.50 - 85.00	48.00 - 48.50	3.241	.498	215.30	3.074	.553	189.02
1C26	84.50 - 85.00	48.50 - 49.00	3.241	.498	233.32	3.074	.553	198.24
1C27	84.50 - 85.00	49.00 - 49.50	3.241	.498	255.80	3.074	.553	212.72
1C28	84.50 - 85.00	49.50 - 50.00	3.206	.541	276.53	3.074	.553	231.48
1C29	85.00 - 85.50	28.00 - 28.50	2.828	.101	252.19	.000	.000	.00
1C30	85.00 - 85.50	28.50 - 29.00	2.901	.028	233.22	.000	.000	.00
1C31	85.00 - 85.50	29.00 - 29.50	2.930	.001	217.14	2.446	.074	299.46
1C32	85.00 - 85.50	29.50 - 30.00	3.109	.129	210.86	2.534	.014	261.96
1C33	85.00 - 85.50	30.00 - 30.50	3.316	.158	239.80	2.534	.014	236.74
1C34	85.00 - 85.50	30.50 - 31.00	3.378	.196	235.07	2.534	.014	212.37
1C35	85.00 - 85.50	31.00 - 31.50	3.472	.105	217.35	2.534	.014	189.21
1C36	85.00 - 85.50	31.50 - 32.00	3.594	.089	210.30	3.016	.241	251.49
1C37	85.00 - 85.50	32.00 - 32.50	3.733	.040	203.47	3.152	.204	255.15
1C38	85.00 - 85.50	32.50 - 33.00	4.528	.829	356.17	3.351	.169	262.97
1C39	85.00 - 85.50	33.00 - 33.50	4.622	.755	349.53	3.585	.162	276.29
1C40	85.00 - 85.50	33.50 - 34.00	4.628	.750	316.95	3.722	.243	287.49
1C41	85.00 - 85.50	34.00 - 34.50	4.638	.742	293.53	3.749	.241	278.87
1C42	85.00 - 85.50	34.50 - 35.00	4.650	.733	267.21	3.749	.241	266.25
1C43	85.00 - 85.50	35.00 - 35.50	4.661	.725	185.04	3.749	.241	253.88
1C44	85.00 - 85.50	35.50 - 36.00	4.663	.723	235.08	3.773	.239	245.21
1C45	85.00 - 85.50	36.00 - 36.50	4.675	.716	208.14	3.773	.239	235.22
1C46	85.00 - 85.50	36.50 - 37.00	4.801	.646	275.84	3.832	.223	233.60
1C47	85.00 - 85.50	37.00 - 37.50	4.812	.660	290.46	3.832	.223	231.21
1C48	85.00 - 85.50	37.50 - 38.00	4.813	.659	281.51	3.800	.232	227.53
1C49	85.00 - 85.50	38.00 - 38.50	4.815	.658	262.14	3.796	.238	233.27
1C50	85.00 - 85.50	38.50 - 39.00	4.812	.660	283.86	3.796	.238	243.01

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1051	85.00 - 85.50	39.00 - 39.50	4.809	.661	295.04	3.796	.238	256.11
1052	85.00 - 85.50	39.50 - 40.00	4.787	.678	283.88	3.796	.238	272.24
1053	85.00 - 85.50	40.00 - 40.50	4.769	.691	265.57	3.719	.236	276.18
1054	85.00 - 85.50	40.50 - 41.00	4.751	.708	264.18	3.693	.236	293.61
1055	85.00 - 85.50	41.00 - 41.50	4.133	.185	138.93	3.572	.267	301.09
1056	85.00 - 85.50	41.50 - 42.00	3.944	.243	115.17	3.317	.349	300.42
1057	85.00 - 85.50	42.00 - 42.50	3.932	.240	71.33	2.881	.298	262.94
1058	85.00 - 85.50	42.50 - 43.00	3.868	.224	130.04	2.621	.255	236.33
1059	85.00 - 85.50	43.00 - 43.50	3.893	.219	180.13	2.621	.255	258.09
1060	85.00 - 85.50	43.50 - 44.00	3.827	.237	198.87	3.148	.361	284.20
1061	85.00 - 85.50	44.00 - 44.50	3.814	.245	220.56	3.080	.559	274.41
1062	85.00 - 85.50	44.50 - 45.00	3.727	.229	229.39	3.080	.559	252.21
1063	85.00 - 85.50	45.00 - 45.50	3.542	.148	213.68	3.080	.559	230.07
1064	85.00 - 85.50	45.50 - 46.00	3.527	.172	218.13	3.080	.559	209.01
1065	85.00 - 85.50	46.00 - 46.50	3.449	.247	210.76	3.074	.553	192.82
1066	85.00 - 85.50	46.50 - 47.00	3.266	.332	181.25	3.074	.553	176.71
1067	85.00 - 85.50	47.00 - 47.50	3.181	.337	164.98	3.074	.553	166.30
1068	85.00 - 85.50	47.50 - 48.00	3.109	.400	156.85	3.074	.553	162.68
1069	85.00 - 85.50	48.00 - 48.50	3.079	.432	166.48	3.074	.553	166.30
1070	85.00 - 85.50	48.50 - 49.00	3.241	.498	216.04	3.074	.553	176.71
1071	85.00 - 85.50	49.00 - 49.50	3.241	.498	240.98	3.074	.553	192.82
1072	85.00 - 85.50	49.50 - 50.00	3.206	.541	263.94	3.074	.553	213.33
1073	85.50 - 86.00	28.00 - 28.50	2.828	.101	267.89	.000	.000	.00
1074	85.50 - 86.00	28.50 - 29.00	2.901	.028	244.99	.000	.000	.00
1075	85.50 - 86.00	29.00 - 29.50	2.930	.001	228.45	2.296	.225	311.59
1076	85.50 - 86.00	29.50 - 30.00	3.109	.129	219.29	2.446	.074	282.20
1077	85.50 - 86.00	30.00 - 30.50	3.316	.158	245.80	2.446	.074	255.61
1078	85.50 - 86.00	30.50 - 31.00	3.378	.196	239.93	2.446	.074	230.35
1079	85.50 - 86.00	31.00 - 31.50	3.576	.104	230.83	2.446	.074	206.96
1080	85.50 - 86.00	31.50 - 32.00	3.709	.123	217.83	3.060	.216	278.43
1081	85.50 - 86.00	32.00 - 32.50	3.787	.132	197.25	3.183	.187	277.04
1082	85.50 - 86.00	32.50 - 33.00	4.599	.771	362.57	3.416	.184	279.48
1083	85.50 - 86.00	33.00 - 33.50	4.644	.737	328.00	3.622	.175	287.17
1084	85.50 - 86.00	33.50 - 34.00	4.649	.733	279.89	3.757	.237	290.26
1085	85.50 - 86.00	34.00 - 34.50	4.667	.720	264.49	3.781	.236	275.63

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1086	85.50 - 86.00	34.50 - 35.00	4.688	.706	264.79	3.781	.236	259.17
1087	85.50 - 86.00	35.00 - 35.50	4.700	.698	249.37	3.781	.236	244.22
1088	85.50 - 86.00	35.50 - 36.00	4.702	.697	247.00	3.803	.236	234.25
1089	85.50 - 86.00	36.00 - 36.50	4.715	.689	243.32	3.803	.236	223.49
1090	85.50 - 86.00	36.50 - 37.00	4.760	.658	254.21	3.832	.207	216.89
1091	85.50 - 86.00	37.00 - 37.50	4.816	.658	273.66	3.832	.207	213.83
1092	85.50 - 86.00	37.50 - 38.00	4.819	.655	256.88	3.822	.214	214.14
1093	85.50 - 86.00	38.00 - 38.50	4.821	.654	164.54	3.818	.221	220.73
1094	85.50 - 86.00	38.50 - 39.00	4.818	.655	259.86	3.818	.221	232.42
1095	85.50 - 86.00	39.00 - 39.50	4.816	.657	284.61	3.818	.221	247.90
1096	85.50 - 86.00	39.50 - 40.00	4.793	.674	290.53	3.818	.221	266.18
1097	85.50 - 86.00	40.00 - 40.50	4.776	.686	294.56	3.745	.216	273.25
1098	85.50 - 86.00	40.50 - 41.00	4.759	.702	303.76	3.707	.224	290.08
1099	85.50 - 86.00	41.00 - 41.50	4.153	.185	160.47	3.592	.251	300.76
1100	85.50 - 86.00	41.50 - 42.00	3.962	.252	124.14	3.317	.349	294.25
1101	85.50 - 86.00	42.00 - 42.50	3.951	.249	74.00	2.881	.298	261.12
1102	85.50 - 86.00	42.50 - 43.00	3.879	.222	134.29	2.621	.255	236.10
1103	85.50 - 86.00	43.00 - 43.50	3.889	.217	184.67	2.621	.255	256.90
1104	85.50 - 86.00	43.50 - 44.00	3.822	.235	203.96	3.148	.361	276.80
1105	85.50 - 86.00	44.00 - 44.50	3.809	.244	223.27	3.080	.559	262.01
1106	85.50 - 86.00	44.50 - 45.00	3.714	.237	225.91	3.080	.559	238.98
1107	85.50 - 86.00	45.00 - 45.50	3.526	.154	203.29	3.080	.559	215.47
1108	85.50 - 86.00	45.50 - 46.00	3.511	.180	202.67	3.080	.559	192.61
1109	85.50 - 86.00	46.00 - 46.50	3.425	.262	187.63	3.074	.553	173.73
1110	85.50 - 86.00	46.50 - 47.00	3.211	.378	146.77	3.074	.553	155.67
1111	85.50 - 86.00	47.00 - 47.50	3.109	.400	127.90	3.074	.553	143.74
1112	85.50 - 86.00	47.50 - 48.00	3.109	.400	134.33	3.074	.553	139.54
1113	85.50 - 86.00	48.00 - 48.50	3.079	.432	145.53	3.074	.553	143.74
1114	85.50 - 86.00	48.50 - 49.00	3.079	.432	166.67	3.074	.553	155.67
1115	85.50 - 86.00	49.00 - 49.50	3.079	.432	192.16	3.074	.553	173.73
1116	85.50 - 86.00	49.50 - 50.00	3.037	.483	214.85	3.074	.553	196.25
1117	86.00 - 86.50	29.00 - 29.50	2.717	.089	195.47	2.296	.225	325.95
1118	86.00 - 86.50	29.50 - 30.00	3.043	.098	221.57	2.446	.074	297.79
1119	86.00 - 86.50	30.00 - 30.50	3.261	.186	244.98	2.446	.074	272.76
1120	86.00 - 86.50	30.50 - 31.00	3.327	.225	238.17	2.446	.074	249.31

SEISMIC MAP OF CONTINENTAL U.S.

GFID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1121	86.00 - 86.50	31.00 - 31.50	3.554	.116	230.72	2.446	.074	228.00
1122	86.00 - 86.50	31.50 - 32.00	3.696	.123	216.53	3.060	.216	284.54
1123	86.00 - 86.50	32.00 - 32.50	3.777	.128	194.30	3.222	.161	282.98
1124	86.00 - 86.50	32.50 - 33.00	4.595	.775	350.72	3.438	.173	277.14
1125	86.00 - 86.50	33.00 - 33.50	4.640	.741	307.27	3.636	.165	282.72
1126	86.00 - 86.50	33.50 - 34.00	4.645	.737	184.21	3.769	.228	282.01
1127	86.00 - 86.50	34.00 - 34.50	4.668	.720	181.61	3.792	.227	264.05
1128	86.00 - 86.50	34.50 - 35.00	4.689	.705	254.07	3.792	.227	245.03
1129	86.00 - 86.50	35.00 - 35.50	4.701	.697	250.91	3.792	.227	228.07
1130	86.00 - 86.50	35.50 - 36.00	4.703	.696	240.89	3.814	.227	217.15
1131	86.00 - 86.50	36.00 - 36.50	4.716	.689	234.71	3.814	.227	205.15
1132	86.00 - 86.50	36.50 - 37.00	4.743	.669	234.35	3.946	.249	212.79
1133	86.00 - 86.50	37.00 - 37.50	4.799	.669	248.92	3.946	.249	208.33
1134	86.00 - 86.50	37.50 - 38.00	4.803	.666	239.30	3.941	.251	208.70
1135	86.00 - 86.50	38.00 - 38.50	4.803	.666	223.48	3.938	.256	216.74
1136	86.00 - 86.50	38.50 - 39.00	4.800	.667	236.84	3.938	.256	231.07
1137	86.00 - 86.50	39.00 - 39.50	4.798	.669	261.36	3.938	.256	249.42
1138	86.00 - 86.50	39.50 - 40.00	4.772	.689	278.56	3.938	.256	270.26
1139	86.00 - 86.50	40.00 - 40.50	4.755	.701	296.43	3.885	.256	284.44
1140	86.00 - 86.50	40.50 - 41.00	4.737	.717	313.42	3.854	.266	304.44
1141	86.00 - 86.50	41.00 - 41.50	4.089	.191	161.24	3.774	.291	322.68
1142	86.00 - 86.50	41.50 - 42.00	3.959	.249	139.43	3.426	.382	303.77
1143	86.00 - 86.50	42.00 - 42.50	3.947	.245	130.16	2.881	.298	254.77
1144	86.00 - 86.50	42.50 - 43.00	3.874	.219	151.11	2.621	.255	231.76
1145	86.00 - 86.50	43.00 - 43.50	3.889	.217	193.44	2.621	.255	252.83
1146	86.00 - 86.50	43.50 - 44.00	3.822	.235	209.50	3.148	.361	269.67
1147	86.00 - 86.50	44.00 - 44.50	3.809	.244	225.02	3.080	.559	250.90
1148	86.00 - 86.50	44.50 - 45.00	3.714	.237	221.58	3.080	.559	227.16
1149	86.00 - 86.50	45.00 - 45.50	3.526	.154	191.43	3.080	.559	202.27
1150	86.00 - 86.50	45.50 - 46.00	3.511	.180	187.15	3.080	.559	177.50
1151	86.00 - 86.50	46.00 - 46.50	3.425	.262	167.48	3.074	.553	155.77
1152	86.00 - 86.50	46.50 - 47.00	3.211	.378	123.07	3.074	.553	135.33
1153	86.00 - 86.50	47.00 - 47.50	3.109	.400	104.37	3.074	.553	121.42
1154	86.00 - 86.50	47.50 - 48.00	3.109	.400	111.66	3.074	.553	116.41
1155	86.00 - 86.50	48.00 - 48.50	3.079	.432	125.50	3.074	.553	121.42

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1156	86.00 - 86.50	48.50 - 49.00	3.079	.432	149.56	3.074	.553	135.33
1157	86.00 - 86.50	49.00 - 49.50	3.079	.432	177.59	3.074	.553	155.77
1158	86.00 - 86.50	49.50 - 50.00	3.037	.483	202.22	3.074	.553	180.54
1159	86.50 - 87.00	29.00 - 29.50	2.901	.028	218.03	2.296	.225	342.15
1160	86.50 - 87.00	29.50 - 30.00	3.095	.137	216.75	2.296	.225	314.98
1161	86.50 - 87.00	30.00 - 30.50	3.303	.176	240.99	2.296	.225	289.37
1162	86.50 - 87.00	30.50 - 31.00	3.303	.176	222.17	2.296	.225	265.79
1163	86.50 - 87.00	31.00 - 31.50	3.537	.093	219.14	2.296	.225	244.81
1164	86.50 - 87.00	31.50 - 32.00	3.684	.109	206.96	3.040	.237	295.78
1165	86.50 - 87.00	32.00 - 32.50	3.766	.120	184.95	3.207	.184	287.02
1166	86.50 - 87.00	32.50 - 33.00	4.592	.777	337.15	3.429	.186	273.70
1167	86.50 - 87.00	33.00 - 33.50	4.638	.742	306.61	3.733	.205	293.72
1168	86.50 - 87.00	33.50 - 34.00	4.643	.738	262.96	3.878	.272	288.87
1169	86.50 - 87.00	34.00 - 34.50	4.666	.722	248.47	3.896	.270	266.05
1170	86.50 - 87.00	34.50 - 35.00	4.686	.708	248.26	3.896	.270	243.51
1171	86.50 - 87.00	35.00 - 35.50	4.698	.699	237.68	3.896	.270	223.53
1172	86.50 - 87.00	35.50 - 36.00	4.700	.698	223.65	3.914	.268	209.76
1173	86.50 - 87.00	36.00 - 36.50	4.714	.690	214.47	3.914	.268	195.65
1174	86.50 - 87.00	36.50 - 37.00	4.741	.671	212.03	3.938	.256	187.52
1175	86.50 - 87.00	37.00 - 37.50	4.797	.671	223.90	3.938	.256	180.77
1176	86.50 - 87.00	37.50 - 38.00	4.801	.668	218.22	3.932	.258	179.80
1177	86.50 - 87.00	38.00 - 38.50	4.801	.668	211.40	3.929	.263	189.91
1178	86.50 - 87.00	38.50 - 39.00	4.798	.669	186.91	3.929	.263	208.22
1179	86.50 - 87.00	39.00 - 39.50	4.795	.671	231.75	3.929	.263	230.33
1180	86.50 - 87.00	39.50 - 40.00	4.770	.691	264.39	3.929	.263	254.15
1181	86.50 - 87.00	40.00 - 40.50	4.752	.704	293.92	3.875	.264	270.54
1182	86.50 - 87.00	40.50 - 41.00	4.733	.720	317.98	3.845	.275	291.63
1183	86.50 - 87.00	41.00 - 41.50	4.082	.193	169.59	3.760	.303	309.95
1184	86.50 - 87.00	41.50 - 42.00	3.957	.250	153.61	3.426	.382	291.08
1185	86.50 - 87.00	42.00 - 42.50	3.945	.247	158.91	2.881	.298	242.88
1186	86.50 - 87.00	42.50 - 43.00	3.871	.221	168.47	2.621	.255	222.32
1187	86.50 - 87.00	43.00 - 43.50	3.878	.222	201.80	2.621	.255	245.43
1188	86.50 - 87.00	43.50 - 44.00	3.809	.244	213.32	3.148	.361	262.95
1189	86.50 - 87.00	44.00 - 44.50	3.795	.253	223.89	3.080	.559	241.25
1190	86.50 - 87.00	44.50 - 45.00	3.697	.249	210.86	3.080	.559	216.96

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1191	86.50 - 87.00	45.00 - 45.50	3.503	.166	169.58	3.080	.559	190.76
1192	86.50 - 87.00	45.50 - 46.00	3.486	.192	165.54	3.080	.559	164.05
1193	86.50 - 87.00	46.00 - 46.50	3.388	.288	141.04	3.074	.553	139.36
1194	86.50 - 87.00	46.50 - 47.00	3.211	.378	99.27	3.074	.553	116.06
1195	86.50 - 87.00	47.00 - 47.50	3.109	.400	80.18	3.074	.553	99.50
1196	86.50 - 87.00	47.50 - 48.00	3.109	.400	89.14	3.074	.553	93.32
1197	86.50 - 87.00	48.00 - 48.50	3.079	.432	107.03	3.074	.553	99.50
1198	86.50 - 87.00	48.50 - 49.00	3.079	.432	134.55	3.074	.553	116.06
1199	86.50 - 87.00	49.00 - 49.50	3.079	.432	165.23	3.074	.553	139.36
1200	86.50 - 87.00	49.50 - 50.00	3.037	.483	191.74	3.074	.553	166.59
1201	87.00 - 87.50	29.00 - 29.50	2.717	.089	172.48	2.296	.225	359.93
1202	87.00 - 87.50	29.50 - 30.00	3.043	.098	204.59	2.296	.225	334.21
1203	87.00 - 87.50	30.00 - 30.50	3.261	.186	227.90	2.296	.225	310.20
1204	87.00 - 87.50	30.50 - 31.00	3.261	.186	209.74	2.296	.225	288.33
1205	87.00 - 87.50	31.00 - 31.50	3.520	.096	212.38	2.296	.225	269.11
1206	87.00 - 87.50	31.50 - 32.00	3.670	.108	199.38	3.040	.237	294.08
1207	87.00 - 87.50	32.00 - 32.50	3.758	.113	172.62	3.207	.184	281.23
1208	87.00 - 87.50	32.50 - 33.00	4.586	.781	313.13	3.429	.186	264.25
1209	87.00 - 87.50	33.00 - 33.50	4.633	.746	301.57	3.715	.222	279.41
1210	87.00 - 87.50	33.50 - 34.00	4.638	.742	275.66	3.863	.287	272.14
1211	87.00 - 87.50	34.00 - 34.50	4.664	.723	255.90	3.882	.284	247.13
1212	87.00 - 87.50	34.50 - 35.00	4.684	.709	237.93	3.882	.284	222.14
1213	87.00 - 87.50	35.00 - 35.50	4.693	.702	218.73	3.882	.284	200.05
1214	87.00 - 87.50	35.50 - 36.00	4.693	.702	200.12	3.882	.284	181.42
1215	87.00 - 87.50	36.00 - 36.50	4.707	.694	188.08	3.882	.284	166.09
1216	87.00 - 87.50	36.50 - 37.00	4.741	.670	185.09	3.914	.268	157.92
1217	87.00 - 87.50	37.00 - 37.50	4.796	.671	193.53	3.914	.268	147.16
1218	87.00 - 87.50	37.50 - 38.00	4.799	.669	183.54	3.908	.270	142.93
1219	87.00 - 87.50	38.00 - 38.50	4.798	.669	178.31	3.908	.270	157.51
1220	87.00 - 87.50	38.50 - 39.00	4.796	.671	140.20	3.908	.270	182.00
1221	87.00 - 87.50	39.00 - 39.50	4.794	.672	182.47	3.908	.270	208.59
1222	87.00 - 87.50	39.50 - 40.00	4.769	.692	246.70	3.908	.270	235.56
1223	87.00 - 87.50	40.00 - 40.50	4.751	.705	287.62	3.852	.272	253.94
1224	87.00 - 87.50	40.50 - 41.00	4.732	.722	317.52	3.820	.284	275.57
1225	87.00 - 87.50	41.00 - 41.50	4.079	.198	174.44	3.727	.317	291.38

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1226	87.00 - 87.50	41.50 - 42.00	3.950	.255	160.54	3.426	.382	275.11
1227	87.00 - 87.50	42.00 - 42.50	3.938	.253	169.82	2.881	.298	224.34
1228	87.00 - 87.50	42.50 - 43.00	3.863	.230	178.34	2.621	.255	207.41
1229	87.00 - 87.50	43.00 - 43.50	3.874	.228	208.09	2.621	.255	234.84
1230	87.00 - 87.50	43.50 - 44.00	3.804	.251	216.73	3.148	.361	256.86
1231	87.00 - 87.50	44.00 - 44.50	3.790	.261	223.10	3.080	.559	233.26
1232	87.00 - 87.50	44.50 - 45.00	3.690	.259	195.78	3.080	.559	208.63
1233	87.00 - 87.50	45.00 - 45.50	3.495	.178	131.31	3.080	.559	181.28
1234	87.00 - 87.50	45.50 - 46.00	3.486	.192	146.50	3.080	.559	152.73
1235	87.00 - 87.50	46.00 - 46.50	3.388	.288	123.13	3.074	.553	125.12
1236	87.00 - 87.50	46.50 - 47.00	3.211	.378	76.21	3.074	.553	98.51
1237	87.00 - 87.50	47.00 - 47.50	3.109	.400	55.30	3.074	.553	78.31
1238	87.00 - 87.50	47.50 - 48.00	3.109	.400	67.63	3.074	.553	70.30
1239	87.00 - 87.50	48.00 - 48.50	3.079	.432	91.22	3.074	.553	78.31
1240	87.00 - 87.50	48.50 - 49.00	3.079	.432	122.48	3.074	.553	98.51
1241	87.00 - 87.50	49.00 - 49.50	3.079	.432	155.65	3.074	.553	125.12
1242	87.00 - 87.50	49.50 - 50.00	3.037	.483	183.81	3.074	.553	154.88
1243	87.50 - 88.00	29.00 - 29.50	2.717	.089	153.75	2.722	.255	318.54
1244	87.50 - 88.00	29.50 - 30.00	2.996	.032	176.56	2.722	.255	322.36
1245	87.50 - 88.00	30.00 - 30.50	3.226	.184	202.30	2.722	.255	326.46
1246	87.50 - 88.00	30.50 - 31.00	3.275	.167	197.65	2.722	.255	330.22
1247	87.50 - 88.00	31.00 - 31.50	3.501	.104	201.52	2.722	.255	333.39
1248	87.50 - 88.00	31.50 - 32.00	3.629	.090	185.32	3.166	.211	313.25
1249	87.50 - 88.00	32.00 - 32.50	3.725	.094	153.10	3.207	.184	274.54
1250	87.50 - 88.00	32.50 - 33.00	4.575	.789	229.62	3.429	.186	254.74
1251	87.50 - 88.00	33.00 - 33.50	4.625	.752	287.02	3.715	.222	266.52
1252	87.50 - 88.00	33.50 - 34.00	4.630	.747	267.89	3.863	.287	257.31
1253	87.50 - 88.00	34.00 - 34.50	4.657	.728	244.93	3.882	.284	229.87
1254	87.50 - 88.00	34.50 - 35.00	4.678	.712	220.87	3.882	.284	202.24
1255	87.50 - 88.00	35.00 - 35.50	4.687	.706	196.53	3.882	.284	177.88
1256	87.50 - 88.00	35.50 - 36.00	4.687	.706	173.76	3.882	.284	157.82
1257	87.50 - 88.00	36.00 - 36.50	4.702	.697	158.69	3.882	.284	141.63
1258	87.50 - 88.00	36.50 - 37.00	4.735	.674	154.17	3.892	.276	128.58
1259	87.50 - 88.00	37.00 - 37.50	4.790	.675	161.31	3.892	.276	112.41
1260	87.50 - 88.00	37.50 - 38.00	4.792	.673	125.19	3.886	.278	96.86

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1261	87.50 - 88.00	38.00 - 38.50	4.792	.674	126.01	3.886	.278	123.56
1262	87.50 - 88.00	38.50 - 39.00	4.789	.675	122.04	3.886	.278	157.13
1263	87.50 - 88.00	39.00 - 39.50	4.787	.677	147.63	3.876	.287	186.46
1264	87.50 - 88.00	39.50 - 40.00	4.761	.697	234.82	3.876	.287	216.66
1265	87.50 - 88.00	40.00 - 40.50	4.743	.710	280.33	3.815	.292	236.48
1266	87.50 - 88.00	40.50 - 41.00	4.723	.728	312.30	3.779	.306	257.99
1267	87.50 - 88.00	41.00 - 41.50	4.062	.194	171.65	3.671	.349	267.80
1268	87.50 - 88.00	41.50 - 42.00	3.931	.247	156.04	3.361	.404	243.70
1269	87.50 - 88.00	42.00 - 42.50	3.918	.244	167.02	2.621	.255	154.30
1270	87.50 - 88.00	42.50 - 43.00	3.837	.221	175.43	2.071	.000	104.04
1271	87.50 - 88.00	43.00 - 43.50	3.862	.248	208.69	2.621	.255	222.13
1272	87.50 - 88.00	43.50 - 44.00	3.788	.277	217.41	3.148	.361	251.71
1273	87.50 - 88.00	44.00 - 44.50	3.772	.288	221.85	3.080	.559	227.11
1274	87.50 - 88.00	44.50 - 45.00	3.668	.294	182.78	3.080	.559	202.39
1275	87.50 - 88.00	45.00 - 45.50	3.467	.224	66.87	3.080	.559	174.16
1276	87.50 - 88.00	45.50 - 46.00	3.467	.224	131.81	3.080	.559	144.07
1277	87.50 - 88.00	46.00 - 46.50	3.388	.288	110.34	3.074	.553	113.86
1278	87.50 - 88.00	46.50 - 47.00	3.211	.378	56.51	3.074	.553	83.75
1279	87.50 - 88.00	47.00 - 47.50	3.109	.400	30.14	3.074	.553	58.67
1280	87.50 - 88.00	47.50 - 48.00	3.109	.400	49.61	3.074	.553	47.46
1281	87.50 - 88.00	48.00 - 48.50	3.079	.432	79.90	3.074	.553	58.67
1282	87.50 - 88.00	48.50 - 49.00	3.079	.432	114.39	3.074	.553	83.75
1283	87.50 - 88.00	49.00 - 49.50	3.079	.432	149.43	3.074	.553	113.86
1284	87.50 - 88.00	49.50 - 50.00	3.037	.483	178.74	3.074	.553	145.93
1285	88.00 - 88.50	28.00 - 28.50	2.566	.061	170.79	2.521	.367	246.88
1286	88.00 - 88.50	28.50 - 29.00	2.677	.049	152.98	2.521	.367	254.01
1287	88.00 - 88.50	29.00 - 29.50	2.677	.049	129.94	2.521	.367	265.47
1288	88.00 - 88.50	29.50 - 30.00	2.978	.054	150.35	2.521	.367	280.72
1289	88.00 - 88.50	30.00 - 30.50	3.211	.203	172.76	2.521	.367	299.19
1290	88.00 - 88.50	30.50 - 31.00	3.261	.186	178.04	2.722	.255	337.55
1291	88.00 - 88.50	31.00 - 31.50	3.495	.112	194.35	2.722	.255	345.51
1292	88.00 - 88.50	31.50 - 32.00	3.625	.096	182.15	3.166	.211	310.35
1293	88.00 - 88.50	32.00 - 32.50	3.723	.094	151.76	3.207	.184	269.13
1294	88.00 - 88.50	32.50 - 33.00	4.575	.790	226.90	3.429	.186	246.15
1295	88.00 - 88.50	33.00 - 33.50	4.624	.752	279.63	3.715	.222	254.61

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1296	88.00 - 88.50	33.50 - 34.00	4.630	.748	257.85	3.863	.287	243.48
1297	88.00 - 88.50	34.00 - 34.50	4.656	.728	230.72	3.882	.284	213.41
1298	88.00 - 88.50	34.50 - 35.00	4.677	.713	202.52	3.882	.284	182.67
1299	88.00 - 88.50	35.00 - 35.50	4.686	.707	174.06	3.882	.284	155.39
1300	88.00 - 88.50	35.50 - 36.00	4.686	.707	147.26	3.882	.284	133.96
1301	88.00 - 88.50	36.00 - 36.50	4.701	.698	127.75	3.882	.284	117.93
1302	88.00 - 88.50	36.50 - 37.00	4.728	.679	119.54	3.892	.276	104.43
1303	88.00 - 88.50	37.00 - 37.50	4.783	.680	125.53	3.892	.276	86.06
1304	88.00 - 88.50	37.50 - 38.00	4.785	.678	143.35	3.886	.278	45.15
1305	88.00 - 88.50	38.00 - 38.50	4.786	.678	157.68	3.886	.278	100.93
1306	88.00 - 88.50	38.50 - 39.00	4.783	.680	171.09	3.886	.278	139.40
1307	88.00 - 88.50	39.00 - 39.50	4.781	.681	197.08	3.876	.287	171.19
1308	88.00 - 88.50	39.50 - 40.00	4.757	.700	236.35	3.876	.287	203.23
1309	88.00 - 88.50	40.00 - 40.50	4.742	.711	275.96	3.815	.292	224.11
1310	88.00 - 88.50	40.50 - 41.00	4.722	.729	307.06	3.779	.306	244.53
1311	88.00 - 88.50	41.00 - 41.50	4.060	.197	164.79	3.671	.349	246.39
1312	88.00 - 88.50	41.50 - 42.00	3.928	.249	134.42	3.361	.404	207.02
1313	88.00 - 88.50	42.00 - 42.50	3.915	.247	155.24	2.621	.255	121.64
1314	88.00 - 88.50	42.50 - 43.00	3.834	.225	164.31	2.071	.000	86.67
1315	88.00 - 88.50	43.00 - 43.50	3.830	.257	196.40	2.071	.000	116.03
1316	88.00 - 88.50	43.50 - 44.00	3.766	.298	213.30	3.080	.559	240.48
1317	88.00 - 88.50	44.00 - 44.50	3.766	.298	224.44	3.080	.559	223.02
1318	88.00 - 88.50	44.50 - 45.00	3.659	.308	193.13	3.080	.559	198.45
1319	88.00 - 88.50	45.00 - 45.50	3.456	.242	124.69	3.080	.559	169.71
1320	88.00 - 88.50	45.50 - 46.00	3.456	.242	135.67	3.080	.559	138.59
1321	88.00 - 88.50	46.00 - 46.50	3.388	.288	105.80	3.074	.553	106.54
1322	88.00 - 88.50	46.50 - 47.00	3.211	.378	47.19	3.074	.553	73.48
1323	88.00 - 88.50	47.00 - 47.50	3.109	.400	12.04	3.074	.553	42.76
1324	88.00 - 88.50	47.50 - 48.00	3.109	.400	41.21	3.074	.553	25.26
1325	88.00 - 88.50	48.00 - 48.50	3.079	.432	75.25	3.074	.553	42.76
1326	88.00 - 88.50	48.50 - 49.00	3.079	.432	111.19	3.074	.553	73.48
1327	88.00 - 88.50	49.00 - 49.50	3.079	.432	147.03	3.074	.553	106.54
1328	88.00 - 88.50	49.50 - 50.00	3.037	.483	176.78	3.074	.553	140.29
1329	88.50 - 89.00	28.00 - 28.50	2.566	.061	156.26	2.521	.367	216.72
1330	88.50 - 89.00	28.50 - 29.00	2.677	.049	138.91	2.521	.367	224.81

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1331	88.50 - 89.00	29.00 - 29.50	2.677	.049	112.34	2.521	.367	237.68
1332	88.50 - 89.00	29.50 - 30.00	2.886	.072	106.21	2.521	.367	254.60
1333	88.50 - 89.00	30.00 - 30.50	3.165	.215	114.01	2.521	.367	274.83
1334	88.50 - 89.00	30.50 - 31.00	3.226	.184	144.85	2.722	.255	315.92
1335	88.50 - 89.00	31.00 - 31.50	3.479	.116	184.43	2.722	.255	324.93
1336	88.50 - 89.00	31.50 - 32.00	3.612	.092	181.24	3.164	.211	299.37
1337	88.50 - 89.00	32.00 - 32.50	3.689	.075	157.01	3.207	.184	259.55
1338	88.50 - 89.00	32.50 - 33.00	4.561	.801	290.03	3.429	.186	236.95
1339	88.50 - 89.00	33.00 - 33.50	4.613	.761	276.12	3.715	.222	243.77
1340	88.50 - 89.00	33.50 - 34.00	4.619	.756	244.38	3.863	.287	231.52
1341	88.50 - 89.00	34.00 - 34.50	4.647	.735	213.57	3.882	.284	199.09
1342	88.50 - 89.00	34.50 - 35.00	4.669	.719	182.72	3.882	.284	164.63
1343	88.50 - 89.00	35.00 - 35.50	4.678	.712	150.35	3.882	.284	132.56
1344	88.50 - 89.00	35.50 - 36.00	4.678	.712	120.80	3.882	.284	108.88
1345	88.50 - 89.00	36.00 - 36.50	4.694	.702	95.57	3.882	.284	94.69
1346	88.50 - 89.00	36.50 - 37.00	4.727	.679	80.09	3.882	.284	81.07
1347	88.50 - 89.00	37.00 - 37.50	4.782	.680	98.40	3.882	.284	58.98
1348	88.50 - 89.00	37.50 - 38.00	4.785	.678	128.13	3.884	.278	66.07
1349	88.50 - 89.00	38.00 - 38.50	4.783	.679	155.51	3.884	.278	92.02
1350	88.50 - 89.00	38.50 - 39.00	4.780	.682	177.09	3.884	.278	126.43
1351	88.50 - 89.00	39.00 - 39.50	4.778	.683	206.13	3.876	.287	159.52
1352	88.50 - 89.00	39.50 - 40.00	4.754	.702	236.55	3.876	.287	193.02
1353	88.50 - 89.00	40.00 - 40.50	4.739	.713	271.43	3.815	.292	214.75
1354	88.50 - 89.00	40.50 - 41.00	4.718	.731	301.46	3.779	.306	233.67
1355	88.50 - 89.00	41.00 - 41.50	4.051	.190	156.90	3.671	.349	220.42
1356	88.50 - 89.00	41.50 - 42.00	3.916	.240	77.04	3.361	.404	143.38
1357	88.50 - 89.00	42.00 - 42.50	3.904	.237	139.62	2.621	.255	90.50
1358	88.50 - 89.00	42.50 - 43.00	3.819	.213	129.85	2.071	.000	74.32
1359	88.50 - 89.00	43.00 - 43.50	3.824	.265	178.97	2.071	.000	107.12
1360	88.50 - 89.00	43.50 - 44.00	3.766	.298	212.03	3.080	.559	237.35
1361	88.50 - 89.00	44.00 - 44.50	3.766	.298	230.08	3.080	.559	221.17
1362	88.50 - 89.00	44.50 - 45.00	3.659	.308	210.86	3.080	.559	196.94
1363	88.50 - 89.00	45.00 - 45.50	3.456	.242	158.88	3.080	.559	168.13
1364	88.50 - 89.00	45.50 - 46.00	3.456	.242	147.55	3.080	.559	136.68
1365	88.50 - 89.00	46.00 - 46.50	3.388	.288	110.96	3.074	.553	103.98

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1366	88.50 - 89.00	46.50 - 47.00	3.211	.378	53.88	3.074	.553	69.72
1367	88.50 - 89.00	47.00 - 47.50	3.109	.400	23.42	3.074	.553	35.92
1368	88.50 - 89.00	47.50 - 48.00	3.109	.400	47.14	3.074	.553	10.00
1369	88.50 - 89.00	48.00 - 48.50	3.079	.432	78.37	3.074	.553	35.92
1370	88.50 - 89.00	48.50 - 49.00	3.176	.353	127.69	3.074	.553	69.72
1371	88.50 - 89.00	49.00 - 49.50	3.176	.353	165.97	3.074	.553	103.98
1372	88.50 - 89.00	49.50 - 50.00	3.147	.394	200.51	3.074	.553	138.36
1373	89.00 - 89.50	28.00 - 28.50	2.622	.061	157.24	2.722	.255	219.08
1374	89.00 - 89.50	28.50 - 29.00	2.733	.049	139.21	2.722	.255	224.89
1375	89.00 - 89.50	29.00 - 29.50	2.733	.049	109.41	2.722	.255	234.43
1376	89.00 - 89.50	29.50 - 30.00	2.942	.072	93.94	2.722	.255	246.14
1377	89.00 - 89.50	30.00 - 30.50	3.221	.215	49.67	2.722	.255	258.96
1378	89.00 - 89.50	30.50 - 31.00	3.282	.184	134.83	2.839	.206	278.51
1379	89.00 - 89.50	31.00 - 31.50	3.523	.134	193.85	2.839	.206	284.33
1380	89.00 - 89.50	31.50 - 32.00	3.656	.111	198.04	3.207	.184	281.68
1381	89.00 - 89.50	32.00 - 32.50	3.724	.069	177.82	3.241	.164	248.56
1382	89.00 - 89.50	32.50 - 33.00	4.609	.808	325.20	3.449	.176	229.52
1383	89.00 - 89.50	33.00 - 33.50	4.663	.767	296.71	3.728	.213	236.40
1384	89.00 - 89.50	33.50 - 34.00	4.669	.762	251.64	3.873	.279	223.82
1385	89.00 - 89.50	34.00 - 34.50	4.698	.739	209.90	3.892	.276	189.84
1386	89.00 - 89.50	34.50 - 35.00	4.720	.723	178.77	3.892	.276	151.42
1387	89.00 - 89.50	35.00 - 35.50	4.730	.716	132.94	3.892	.276	110.64
1388	89.00 - 89.50	35.50 - 36.00	4.730	.716	106.71	3.882	.284	77.84
1389	89.00 - 89.50	36.00 - 36.50	4.734	.713	69.89	3.882	.284	70.38
1390	89.00 - 89.50	36.50 - 37.00	4.779	.683	49.52	3.882	.284	59.56
1391	89.00 - 89.50	37.00 - 37.50	4.778	.684	56.80	3.882	.284	38.97
1392	89.00 - 89.50	37.50 - 38.00	4.781	.682	110.90	3.886	.278	40.81
1393	89.00 - 89.50	38.00 - 38.50	4.781	.682	142.66	3.886	.278	79.63
1394	89.00 - 89.50	38.50 - 39.00	4.777	.684	154.74	3.886	.278	115.47
1395	89.00 - 89.50	39.00 - 39.50	4.775	.685	198.06	3.876	.287	151.46
1396	89.00 - 89.50	39.50 - 40.00	4.747	.707	229.35	3.876	.287	186.26
1397	89.00 - 89.50	40.00 - 40.50	4.732	.718	263.16	3.815	.292	208.76
1398	89.00 - 89.50	40.50 - 41.00	4.714	.735	296.14	3.779	.306	227.36
1399	89.00 - 89.50	41.00 - 41.50	4.046	.196	160.94	3.671	.349	202.75
1400	89.00 - 89.50	41.50 - 42.00	3.911	.245	130.52	3.361	.404	62.79

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1401	89.00 - 89.50	42.00 - 42.50	3.898	.242	138.32	2.621	.255	75.26
1402	89.00 - 89.50	42.50 - 43.00	3.812	.221	66.35	2.071	.000	69.72
1403	89.00 - 89.50	43.00 - 43.50	3.820	.251	166.71	2.071	.000	103.98
1404	89.00 - 89.50	43.50 - 44.00	3.762	.282	213.45	3.080	.559	237.09
1405	89.00 - 89.50	44.00 - 44.50	3.762	.282	236.27	3.080	.559	221.69
1406	89.00 - 89.50	44.50 - 45.00	3.651	.291	222.09	3.080	.559	197.92
1407	89.00 - 89.50	45.00 - 45.50	3.437	.217	170.61	3.080	.559	169.50
1408	89.00 - 89.50	45.50 - 46.00	3.437	.217	155.05	3.080	.559	138.51
1409	89.00 - 89.50	46.00 - 46.50	3.373	.253	120.88	3.074	.553	106.54
1410	89.00 - 89.50	46.50 - 47.00	3.281	.319	78.46	3.074	.553	73.48
1411	89.00 - 89.50	47.00 - 47.50	3.200	.322	54.43	3.074	.553	42.76
1412	89.00 - 89.50	47.50 - 48.00	3.200	.322	71.33	3.074	.553	25.26
1413	89.00 - 89.50	48.00 - 48.50	3.176	.353	100.02	3.074	.553	42.76
1414	89.00 - 89.50	48.50 - 49.00	3.176	.353	135.09	3.074	.553	73.48
1415	89.00 - 89.50	49.00 - 49.50	3.176	.353	171.27	3.074	.553	106.54
1416	89.00 - 89.50	49.50 - 50.00	3.147	.394	204.42	3.074	.553	140.29
1417	89.50 - 90.00	28.00 - 28.50	2.622	.061	147.88	2.722	.255	187.52
1418	89.50 - 90.00	28.50 - 29.00	2.733	.049	130.79	2.722	.255	195.63
1419	89.50 - 90.00	29.00 - 29.50	2.733	.049	103.14	2.722	.255	207.69
1420	89.50 - 90.00	29.50 - 30.00	2.942	.072	99.91	2.722	.255	221.41
1421	89.50 - 90.00	30.00 - 30.50	3.221	.215	112.02	2.722	.255	235.37
1422	89.50 - 90.00	30.50 - 31.00	3.282	.184	142.38	2.839	.206	256.96
1423	89.50 - 90.00	31.00 - 31.50	3.561	.152	198.76	2.839	.206	263.07
1424	89.50 - 90.00	31.50 - 32.00	3.679	.136	203.61	3.207	.184	271.55
1425	89.50 - 90.00	32.00 - 32.50	3.747	.087	186.11	3.241	.164	241.65
1426	89.50 - 90.00	32.50 - 33.00	4.615	.804	329.13	3.449	.176	224.55
1427	89.50 - 90.00	33.00 - 33.50	4.667	.764	295.78	3.728	.213	231.08
1428	89.50 - 90.00	33.50 - 34.00	4.673	.759	243.10	3.873	.279	218.58
1429	89.50 - 90.00	34.00 - 34.50	4.702	.737	157.15	3.892	.276	183.84
1430	89.50 - 90.00	34.50 - 35.00	4.724	.721	164.45	3.892	.276	143.31
1431	89.50 - 90.00	35.00 - 35.50	4.733	.714	121.56	3.892	.276	95.28
1432	89.50 - 90.00	35.50 - 36.00	4.733	.714	81.98	3.882	.284	37.57
1433	89.50 - 90.00	36.00 - 36.50	4.737	.711	52.97	3.882	.284	44.55
1434	89.50 - 90.00	36.50 - 37.00	4.738	.711	20.36	3.882	.284	30.97
1435	89.50 - 90.00	37.00 - 37.50	4.737	.712	59.42	3.882	.284	56.88

* SEISMIC MAP OF CONTINENTAL U.S. *

GFID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1436	89.50 - 90.00	37.50 - 38.00	4.740	.710	101.70	3.886	.278	64.28
1437	89.50 - 90.00	38.00 - 38.50	4.740	.710	110.66	3.886	.278	53.68
1438	89.50 - 90.00	38.50 - 39.00	4.735	.713	137.10	3.886	.278	108.94
1439	89.50 - 90.00	39.00 - 39.50	4.733	.714	169.95	3.876	.287	147.82
1440	89.50 - 90.00	39.50 - 40.00	4.698	.742	207.04	3.876	.287	183.16
1441	89.50 - 90.00	40.00 - 40.50	4.682	.754	233.88	3.815	.292	206.29
1442	89.50 - 90.00	40.50 - 41.00	4.665	.770	277.84	3.779	.306	226.78
1443	89.50 - 90.00	41.00 - 41.50	3.892	.214	139.99	3.671	.349	216.04
1444	89.50 - 90.00	41.50 - 42.00	3.866	.186	148.75	3.361	.404	142.77
1445	89.50 - 90.00	42.00 - 42.50	3.856	.185	152.18	2.621	.255	90.27
1446	89.50 - 90.00	42.50 - 43.00	3.702	.168	119.58	2.071	.000	74.32
1447	89.50 - 90.00	43.00 - 43.50	3.820	.251	185.08	2.071	.000	107.12
1448	89.50 - 90.00	43.50 - 44.00	3.762	.282	223.18	3.080	.559	239.93
1449	89.50 - 90.00	44.00 - 44.50	3.762	.282	246.50	3.080	.559	224.62
1450	89.50 - 90.00	44.50 - 45.00	3.642	.306	233.94	3.080	.559	201.37
1451	89.50 - 90.00	45.00 - 45.50	3.425	.237	182.31	3.080	.559	173.74
1452	89.50 - 90.00	45.50 - 46.00	3.425	.237	167.43	3.080	.559	143.91
1453	89.50 - 90.00	46.00 - 46.50	3.358	.277	136.81	3.074	.553	113.86
1454	89.50 - 90.00	46.50 - 47.00	3.260	.349	100.24	3.074	.553	83.75
1455	89.50 - 90.00	47.00 - 47.50	3.176	.353	80.93	3.074	.553	58.67
1456	89.50 - 90.00	47.50 - 48.00	3.176	.353	91.56	3.074	.553	47.46
1457	89.50 - 90.00	48.00 - 48.50	3.176	.353	116.03	3.074	.553	58.67
1458	89.50 - 90.00	48.50 - 49.00	3.176	.353	146.71	3.074	.553	83.75
1459	89.50 - 90.00	49.00 - 49.50	3.176	.353	179.99	3.074	.553	113.86
1460	89.50 - 90.00	49.50 - 50.00	3.147	.394	211.16	3.074	.553	145.93
1461	90.00 - 90.50	28.00 - 28.50	2.622	.061	141.24	2.722	.255	155.45
1462	90.00 - 90.50	28.50 - 29.00	2.733	.049	124.02	2.722	.255	166.85
1463	90.00 - 90.50	29.00 - 29.50	2.733	.049	96.24	2.722	.255	182.30
1464	90.00 - 90.50	29.50 - 30.00	2.942	.072	96.54	2.722	.255	198.38
1465	90.00 - 90.50	30.00 - 30.50	3.221	.215	119.77	2.722	.255	213.29
1466	90.00 - 90.50	30.50 - 31.00	3.282	.184	139.21	2.839	.206	236.28
1467	90.00 - 90.50	31.00 - 31.50	3.548	.171	193.48	2.839	.206	242.39
1468	90.00 - 90.50	31.50 - 32.00	3.670	.151	203.38	3.207	.184	262.18
1469	90.00 - 90.50	32.00 - 32.50	3.739	.094	188.49	3.241	.164	236.23
1470	90.00 - 90.50	32.50 - 33.00	4.612	.807	332.03	3.449	.176	221.78

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	B(N)	R(N)
1471	90.00 - 90.50	33.00 - 33.50	4.664	.767	298.29	3.728	.213	228.68
1472	90.00 - 90.50	33.50 - 34.00	4.671	.762	249.67	3.873	.279	217.11
1473	90.00 - 90.50	34.00 - 34.50	4.700	.739	203.85	3.892	.276	183.25
1474	90.00 - 90.50	34.50 - 35.00	4.722	.723	159.47	3.892	.276	144.39
1475	90.00 - 90.50	35.00 - 35.50	4.731	.716	77.96	3.892	.276	101.28
1476	90.00 - 90.50	35.50 - 36.00	4.731	.716	74.09	3.882	.284	55.79
1477	90.00 - 90.50	36.00 - 36.50	4.735	.713	73.42	3.882	.284	61.33
1478	90.00 - 90.50	36.50 - 37.00	4.740	.709	51.17	3.882	.284	42.58
1479	90.00 - 90.50	37.00 - 37.50	4.739	.710	77.25	3.882	.284	60.13
1480	90.00 - 90.50	37.50 - 38.00	4.743	.708	109.16	3.886	.278	61.09
1481	90.00 - 90.50	38.00 - 38.50	4.742	.708	89.58	3.886	.278	83.09
1482	90.00 - 90.50	38.50 - 39.00	4.735	.713	87.52	3.886	.278	114.39
1483	90.00 - 90.50	39.00 - 39.50	4.733	.714	122.99	3.876	.287	149.10
1484	90.00 - 90.50	39.50 - 40.00	4.698	.742	199.35	3.876	.287	183.74
1485	90.00 - 90.50	40.00 - 40.50	4.682	.753	170.28	3.815	.292	207.14
1486	90.00 - 90.50	40.50 - 41.00	4.666	.769	271.69	3.779	.306	230.31
1487	90.00 - 90.50	41.00 - 41.50	3.895	.212	137.54	3.671	.349	235.52
1488	90.00 - 90.50	41.50 - 42.00	3.870	.181	134.27	3.361	.404	204.06
1489	90.00 - 90.50	42.00 - 42.50	3.860	.179	160.43	2.621	.255	120.70
1490	90.00 - 90.50	42.50 - 43.00	3.708	.160	159.59	2.071	.000	86.67
1491	90.00 - 90.50	43.00 - 43.50	3.594	.167	170.14	2.071	.000	116.03
1492	90.00 - 90.50	43.50 - 44.00	3.493	.210	186.05	3.080	.559	245.69
1493	90.00 - 90.50	44.00 - 44.50	3.493	.210	203.38	3.080	.559	229.88
1494	90.00 - 90.50	44.50 - 45.00	3.425	.237	199.82	3.080	.559	207.16
1495	90.00 - 90.50	45.00 - 45.50	3.425	.237	194.32	3.080	.559	180.65
1496	90.00 - 90.50	45.50 - 46.00	3.425	.237	182.07	3.080	.559	152.47
1497	90.00 - 90.50	46.00 - 46.50	3.358	.277	156.70	3.074	.553	125.12
1498	90.00 - 90.50	46.50 - 47.00	3.260	.349	124.76	3.074	.553	98.51
1499	90.00 - 90.50	47.00 - 47.50	3.176	.353	107.24	3.074	.553	78.31
1500	90.00 - 90.50	47.50 - 48.00	3.176	.353	115.19	3.074	.553	70.30
1501	90.00 - 90.50	48.00 - 48.50	3.176	.353	134.75	3.074	.553	78.31
1502	90.00 - 90.50	48.50 - 49.00	3.176	.353	161.20	3.074	.553	98.51
1503	90.00 - 90.50	49.00 - 49.50	3.176	.353	191.33	3.074	.553	125.12
1504	90.00 - 90.50	49.50 - 50.00	3.147	.394	220.24	3.074	.553	154.88
1505	90.50 - 91.00	28.00 - 28.50	2.890	.122	180.98	2.722	.255	122.94

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1506	90.50 - 91.00	28.50 - 29.00	2.942	.072	148.87	2.722	.255	139.20
1507	90.50 - 91.00	29.00 - 29.50	2.942	.072	112.11	2.722	.255	159.10
1508	90.50 - 91.00	29.50 - 30.00	3.119	.160	94.93	2.722	.255	177.70
1509	90.50 - 91.00	30.00 - 30.50	3.379	.197	95.36	2.722	.255	192.97
1510	90.50 - 91.00	30.50 - 31.00	3.420	.179	132.47	2.839	.206	216.30
1511	90.50 - 91.00	31.00 - 31.50	3.612	.160	192.25	2.839	.206	221.87
1512	90.50 - 91.00	31.50 - 32.00	3.715	.154	205.53	3.207	.184	252.87
1513	90.50 - 91.00	32.00 - 32.50	3.777	.113	192.65	3.241	.164	231.70
1514	90.50 - 91.00	32.50 - 33.00	4.624	.797	337.90	3.449	.176	220.81
1515	90.50 - 91.00	33.00 - 33.50	4.675	.759	306.27	3.728	.213	228.77
1516	90.50 - 91.00	33.50 - 34.00	4.680	.754	262.13	3.873	.279	218.83
1517	90.50 - 91.00	34.00 - 34.50	4.704	.737	221.78	3.892	.276	187.03
1518	90.50 - 91.00	34.50 - 35.00	4.725	.721	178.31	3.892	.276	152.24
1519	90.50 - 91.00	35.00 - 35.50	4.734	.714	135.80	3.892	.276	117.66
1520	90.50 - 91.00	35.50 - 36.00	4.734	.714	116.64	3.882	.284	87.56
1521	90.50 - 91.00	36.00 - 36.50	4.736	.713	98.42	3.882	.284	58.19
1522	90.50 - 91.00	36.50 - 37.00	4.740	.710	92.81	3.882	.284	61.47
1523	90.50 - 91.00	37.00 - 37.50	4.739	.711	97.14	3.882	.284	45.35
1524	90.50 - 91.00	37.50 - 38.00	4.742	.708	126.56	3.886	.278	63.03
1525	90.50 - 91.00	38.00 - 38.50	4.739	.711	117.09	3.886	.278	89.57
1526	90.50 - 91.00	38.50 - 39.00	4.732	.716	134.19	3.886	.278	121.60
1527	90.50 - 91.00	39.00 - 39.50	4.730	.717	176.31	3.876	.287	153.94
1528	90.50 - 91.00	39.50 - 40.00	4.696	.744	213.38	3.876	.287	187.67
1529	90.50 - 91.00	40.00 - 40.50	4.680	.755	233.40	3.815	.292	211.00
1530	90.50 - 91.00	40.50 - 41.00	4.665	.770	281.75	3.779	.306	236.12
1531	90.50 - 91.00	41.00 - 41.50	3.891	.207	136.14	3.671	.349	249.44
1532	90.50 - 91.00	41.50 - 42.00	3.864	.174	75.19	3.361	.404	237.44
1533	90.50 - 91.00	42.00 - 42.50	3.854	.172	161.31	2.621	.255	151.93
1534	90.50 - 91.00	42.50 - 43.00	3.698	.150	178.60	2.071	.000	104.04
1535	90.50 - 91.00	43.00 - 43.50	3.616	.153	191.02	2.071	.000	129.52
1536	90.50 - 91.00	43.50 - 44.00	3.525	.184	202.81	3.080	.559	253.89
1537	90.50 - 91.00	44.00 - 44.50	3.525	.184	216.71	3.080	.559	237.28
1538	90.50 - 91.00	44.50 - 45.00	3.437	.217	210.69	3.080	.559	215.11
1539	90.50 - 91.00	45.00 - 45.50	3.437	.217	206.75	3.080	.559	189.91
1540	90.50 - 91.00	45.50 - 46.00	3.437	.217	197.68	3.080	.559	163.66

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1541	90.50 - 91.00	46.00 - 46.50	3.373	.253	178.30	3.074	.553	139.36
1542	90.50 - 91.00	46.50 - 47.00	3.281	.319	150.97	3.074	.553	116.06
1543	90.50 - 91.00	47.00 - 47.50	3.200	.322	134.96	3.074	.553	99.50
1544	90.50 - 91.00	47.50 - 48.00	3.176	.353	138.15	3.074	.553	93.32
1545	90.50 - 91.00	48.00 - 48.50	3.176	.353	154.34	3.074	.553	99.50
1546	90.50 - 91.00	48.50 - 49.00	3.176	.353	177.26	3.074	.553	116.06
1547	90.50 - 91.00	49.00 - 49.50	3.176	.353	204.45	3.074	.553	139.36
1548	90.50 - 91.00	49.50 - 50.00	3.147	.394	231.11	3.074	.553	166.59
1549	91.00 - 91.50	28.00 - 28.50	2.890	.122	179.52	2.722	.255	90.62
1550	91.00 - 91.50	28.50 - 29.00	2.942	.072	147.19	2.722	.255	114.16
1551	91.00 - 91.50	29.00 - 29.50	2.942	.072	107.27	2.722	.255	139.46
1552	91.00 - 91.50	29.50 - 30.00	2.980	.071	63.45	2.722	.255	160.19
1553	91.00 - 91.50	30.00 - 30.50	3.232	.080	27.38	2.722	.255	174.53
1554	91.00 - 91.50	30.50 - 31.00	3.283	.059	92.12	2.839	.206	196.48
1555	91.00 - 91.50	31.00 - 31.50	3.551	.112	175.92	2.839	.206	200.68
1556	91.00 - 91.50	31.50 - 32.00	3.669	.113	196.74	3.207	.184	242.52
1557	91.00 - 91.50	32.00 - 32.50	3.732	.080	185.32	3.241	.164	227.22
1558	91.00 - 91.50	32.50 - 33.00	4.612	.806	340.65	3.449	.176	221.07
1559	91.00 - 91.50	33.00 - 33.50	4.665	.765	311.16	3.728	.213	230.73
1560	91.00 - 91.50	33.50 - 34.00	4.671	.761	270.41	3.873	.279	222.51
1561	91.00 - 91.50	34.00 - 34.50	4.695	.742	235.06	3.892	.276	192.79
1562	91.00 - 91.50	34.50 - 35.00	4.718	.725	201.54	3.892	.276	162.32
1563	91.00 - 91.50	35.00 - 35.50	4.728	.718	171.85	3.892	.276	134.53
1564	91.00 - 91.50	35.50 - 36.00	4.728	.718	149.52	3.882	.284	108.56
1565	91.00 - 91.50	36.00 - 36.50	4.729	.716	133.22	3.882	.284	87.40
1566	91.00 - 91.50	36.50 - 37.00	4.738	.711	130.03	3.882	.284	66.56
1567	91.00 - 91.50	37.00 - 37.50	4.737	.712	136.23	3.882	.284	26.22
1568	91.00 - 91.50	37.50 - 38.00	4.740	.710	153.12	3.886	.278	39.88
1569	91.00 - 91.50	38.00 - 38.50	4.735	.713	164.10	3.886	.278	90.60
1570	91.00 - 91.50	38.50 - 39.00	4.728	.718	181.78	3.886	.278	128.99
1571	91.00 - 91.50	39.00 - 39.50	4.727	.719	212.15	3.876	.287	161.60
1572	91.00 - 91.50	39.50 - 40.00	4.693	.746	235.56	3.876	.287	194.67
1573	91.00 - 91.50	40.00 - 40.50	4.676	.757	216.69	3.815	.292	217.62
1574	91.00 - 91.50	40.50 - 41.00	4.660	.773	296.38	3.779	.306	243.68
1575	91.00 - 91.50	41.00 - 41.50	3.881	.200	148.25	3.671	.349	260.60

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1576	91.00 - 91.50	41.50 - 42.00	3.848	.165	142.14	3.361	.404	259.40
1577	91.00 - 91.50	42.00 - 42.50	3.837	.164	178.54	2.621	.255	180.18
1578	91.00 - 91.50	42.50 - 43.00	3.704	.143	195.85	2.071	.000	124.34
1579	91.00 - 91.50	43.00 - 43.50	3.671	.166	218.48	2.071	.000	146.33
1580	91.00 - 91.50	43.50 - 44.00	3.540	.208	221.33	3.080	.559	263.99
1581	91.00 - 91.50	44.00 - 44.50	3.502	.194	224.73	3.080	.559	246.58
1582	91.00 - 91.50	44.50 - 45.00	3.408	.233	217.61	3.080	.559	224.99
1583	91.00 - 91.50	45.00 - 45.50	3.408	.233	213.74	3.080	.559	201.19
1584	91.00 - 91.50	45.50 - 46.00	3.408	.233	206.39	3.080	.559	176.97
1585	91.00 - 91.50	46.00 - 46.50	3.333	.281	188.40	3.074	.553	155.77
1586	91.00 - 91.50	46.50 - 47.00	3.281	.319	171.23	3.074	.553	135.33
1587	91.00 - 91.50	47.00 - 47.50	3.200	.322	156.59	3.074	.553	121.42
1588	91.00 - 91.50	47.50 - 48.00	3.176	.353	159.39	3.074	.553	116.41
1589	91.00 - 91.50	48.00 - 48.50	3.176	.353	173.51	3.074	.553	121.42
1590	91.00 - 91.50	48.50 - 49.00	3.176	.353	193.83	3.074	.553	135.33
1591	91.00 - 91.50	49.00 - 49.50	3.176	.353	218.57	3.074	.553	155.77
1592	91.00 - 91.50	49.50 - 50.00	3.147	.394	243.19	3.074	.553	180.54
1593	91.50 - 92.00	28.00 - 28.50	2.989	.115	198.07	2.722	.255	61.53
1594	91.50 - 92.00	28.50 - 29.00	3.034	.054	166.22	2.722	.255	95.03
1595	91.50 - 92.00	29.00 - 29.50	3.034	.054	127.57	2.722	.255	125.35
1596	91.50 - 92.00	29.50 - 30.00	3.068	.021	88.93	2.722	.255	146.61
1597	91.50 - 92.00	30.00 - 30.50	3.283	.059	83.93	2.722	.255	157.72
1598	91.50 - 92.00	30.50 - 31.00	3.325	.067	116.86	2.839	.206	175.68
1599	91.50 - 92.00	31.00 - 31.50	3.571	.105	183.17	2.839	.206	177.26
1600	91.50 - 92.00	31.50 - 32.00	3.681	.117	198.39	3.207	.184	229.31
1601	91.50 - 92.00	32.00 - 32.50	3.741	.090	186.69	3.241	.164	221.68
1602	91.50 - 92.00	32.50 - 33.00	4.615	.803	347.89	3.449	.176	222.03
1603	91.50 - 92.00	33.00 - 33.50	4.668	.763	317.62	3.728	.213	233.99
1604	91.50 - 92.00	33.50 - 34.00	4.673	.758	274.23	3.873	.279	226.73
1605	91.50 - 92.00	34.00 - 34.50	4.697	.740	246.95	3.892	.276	196.77
1606	91.50 - 92.00	34.50 - 35.00	4.719	.724	216.97	3.892	.276	169.08
1607	91.50 - 92.00	35.00 - 35.50	4.729	.717	199.85	3.892	.276	148.61
1608	91.50 - 92.00	35.50 - 36.00	4.729	.717	180.62	3.882	.284	127.48
1609	91.50 - 92.00	36.00 - 36.50	4.730	.716	152.75	3.882	.284	107.51
1610	91.50 - 92.00	36.50 - 37.00	4.740	.709	164.64	3.882	.284	83.96

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1611	91.50 - 92.00	37.00 - 37.50	4.739	.710	168.98	3.882	.284	62.83
1612	91.50 - 92.00	37.50 - 38.00	4.742	.708	183.44	3.886	.278	74.10
1613	91.50 - 92.00	38.00 - 38.50	4.741	.709	199.64	3.886	.278	105.66
1614	91.50 - 92.00	38.50 - 39.00	4.738	.711	219.19	3.886	.278	141.05
1615	91.50 - 92.00	39.00 - 39.50	4.737	.712	245.02	3.876	.287	172.66
1616	91.50 - 92.00	39.50 - 40.00	4.704	.739	263.91	3.876	.287	204.72
1617	91.50 - 92.00	40.00 - 40.50	4.688	.749	283.75	3.815	.292	226.89
1618	91.50 - 92.00	40.50 - 41.00	4.673	.764	322.21	3.779	.306	253.10
1619	91.50 - 92.00	41.00 - 41.50	3.915	.215	170.83	3.671	.349	271.42
1620	91.50 - 92.00	41.50 - 42.00	3.908	.165	195.11	3.361	.404	277.05
1621	91.50 - 92.00	42.00 - 42.50	3.898	.165	216.47	2.621	.255	205.51
1622	91.50 - 92.00	42.50 - 43.00	3.784	.148	229.20	2.071	.000	146.37
1623	91.50 - 92.00	43.00 - 43.50	3.693	.169	230.89	2.071	.000	165.45
1624	91.50 - 92.00	43.50 - 44.00	3.573	.198	233.71	3.080	.559	275.55
1625	91.50 - 92.00	44.00 - 44.50	3.541	.182	236.93	3.080	.559	257.53
1626	91.50 - 92.00	44.50 - 45.00	3.458	.209	232.47	3.080	.559	236.57
1627	91.50 - 92.00	45.00 - 45.50	3.458	.209	229.52	3.080	.559	214.18
1628	91.50 - 92.00	45.50 - 46.00	3.398	.214	212.40	3.080	.559	191.93
1629	91.50 - 92.00	46.00 - 46.50	3.314	.277	195.12	3.074	.553	173.73
1630	91.50 - 92.00	46.50 - 47.00	3.314	.277	191.61	3.074	.553	155.67
1631	91.50 - 92.00	47.00 - 47.50	3.200	.322	174.36	3.074	.553	143.74
1632	91.50 - 92.00	47.50 - 48.00	3.176	.353	178.00	3.074	.553	139.54
1633	91.50 - 92.00	48.00 - 48.50	3.176	.353	191.33	3.074	.553	143.74
1634	91.50 - 92.00	48.50 - 49.00	3.176	.353	210.07	3.074	.553	155.67
1635	91.50 - 92.00	49.00 - 49.50	3.176	.353	233.02	3.074	.553	173.73
1636	91.50 - 92.00	49.50 - 50.00	3.147	.394	256.02	3.074	.553	196.25
1637	92.00 - 92.50	28.00 - 28.50	2.989	.115	204.17	2.722	.255	47.27
1638	92.00 - 92.50	28.50 - 29.00	3.034	.054	176.50	2.722	.255	87.17
1639	92.00 - 92.50	29.00 - 29.50	3.034	.054	145.05	2.722	.255	118.70
1640	92.00 - 92.50	29.50 - 30.00	3.068	.021	119.42	2.722	.255	137.28
1641	92.00 - 92.50	30.00 - 30.50	3.283	.059	135.32	2.722	.255	141.84
1642	92.00 - 92.50	30.50 - 31.00	3.325	.067	147.34	2.839	.206	151.96
1643	92.00 - 92.50	31.00 - 31.50	3.571	.105	193.34	2.839	.206	149.05
1644	92.00 - 92.50	31.50 - 32.00	3.681	.117	201.36	3.207	.184	210.30
1645	92.00 - 92.50	32.00 - 32.50	3.741	.090	188.74	3.241	.164	213.83

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1646	92.00 - 92.50	32.50 - 33.00	4.615	.803	357.14	3.449	.176	223.41
1647	92.00 - 92.50	33.00 - 33.50	4.668	.763	323.89	3.728	.213	238.59
1648	92.00 - 92.50	33.50 - 34.00	4.673	.758	230.52	3.873	.279	231.03
1649	92.00 - 92.50	34.00 - 34.50	4.697	.740	255.11	3.892	.276	193.45
1650	92.00 - 92.50	34.50 - 35.00	4.714	.728	179.10	3.892	.276	156.50
1651	92.00 - 92.50	35.00 - 35.50	4.730	.716	223.74	3.892	.276	156.91
1652	92.00 - 92.50	35.50 - 36.00	4.734	.714	213.22	3.882	.284	145.45
1653	92.00 - 92.50	36.00 - 36.50	4.735	.713	200.20	3.882	.284	128.70
1654	92.00 - 92.50	36.50 - 37.00	4.741	.708	197.95	3.882	.284	111.08
1655	92.00 - 92.50	37.00 - 37.50	4.744	.707	180.28	3.882	.284	100.57
1656	92.00 - 92.50	37.50 - 38.00	4.748	.704	214.58	3.886	.278	108.07
1657	92.00 - 92.50	38.00 - 38.50	4.746	.706	231.97	3.886	.278	129.96
1658	92.00 - 92.50	38.50 - 39.00	4.745	.707	251.67	3.886	.278	158.68
1659	92.00 - 92.50	39.00 - 39.50	4.744	.707	274.94	3.876	.287	187.46
1660	92.00 - 92.50	39.50 - 40.00	4.709	.735	291.16	3.876	.287	217.80
1661	92.00 - 92.50	40.00 - 40.50	4.694	.745	316.21	3.815	.292	238.71
1662	92.00 - 92.50	40.50 - 41.00	4.679	.759	346.57	3.779	.306	264.49
1663	92.00 - 92.50	41.00 - 41.50	3.931	.222	187.12	3.671	.349	283.06
1664	92.00 - 92.50	41.50 - 42.00	3.936	.164	221.18	3.361	.404	293.38
1665	92.00 - 92.50	42.00 - 42.50	3.926	.164	237.94	2.621	.255	228.78
1666	92.00 - 92.50	42.50 - 43.00	3.820	.150	245.53	2.071	.000	169.44
1667	92.00 - 92.50	43.00 - 43.50	3.708	.165	238.98	2.071	.000	186.18
1668	92.00 - 92.50	43.50 - 44.00	3.594	.188	240.59	3.080	.559	288.26
1669	92.00 - 92.50	44.00 - 44.50	3.563	.171	242.49	3.080	.559	269.87
1670	92.00 - 92.50	44.50 - 45.00	3.486	.192	238.90	3.080	.559	249.60
1671	92.00 - 92.50	45.00 - 45.50	3.486	.192	235.94	3.080	.559	228.58
1672	92.00 - 92.50	45.50 - 46.00	3.430	.196	220.98	3.080	.559	208.16
1673	92.00 - 92.50	46.00 - 46.50	3.361	.240	209.41	3.074	.553	192.82
1674	92.00 - 92.50	46.50 - 47.00	3.361	.240	209.76	3.074	.553	176.71
1675	92.00 - 92.50	47.00 - 47.50	3.200	.322	187.06	3.074	.553	166.30
1676	92.00 - 92.50	47.50 - 48.00	3.176	.353	193.15	3.074	.553	162.68
1677	92.00 - 92.50	48.00 - 48.50	3.176	.353	207.09	3.074	.553	166.30
1678	92.00 - 92.50	48.50 - 49.00	3.176	.353	225.38	3.074	.553	176.71
1679	92.00 - 92.50	49.00 - 49.50	3.176	.353	247.34	3.074	.553	192.82
1680	92.00 - 92.50	49.50 - 50.00	3.147	.394	269.18	3.074	.553	213.33

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1681	92.50 - 93.00	28.00 - 28.50	2.989	.115	212.30	2.722	.255	61.23
1682	92.50 - 93.00	28.50 - 29.00	3.013	.082	186.70	2.722	.255	93.49
1683	92.50 - 93.00	29.00 - 29.50	3.013	.082	161.22	2.722	.255	119.87
1684	92.50 - 93.00	29.50 - 30.00	3.052	.032	142.89	2.722	.255	131.89
1685	92.50 - 93.00	30.00 - 30.50	3.272	.075	164.87	2.722	.255	126.37
1686	92.50 - 93.00	30.50 - 31.00	3.314	.082	166.03	2.839	.206	123.27
1687	92.50 - 93.00	31.00 - 31.50	3.583	.111	202.71	2.839	.206	112.54
1688	92.50 - 93.00	31.50 - 32.00	3.689	.126	204.48	3.207	.184	181.51
1689	92.50 - 93.00	32.00 - 32.50	3.748	.100	191.52	3.241	.164	202.89
1690	92.50 - 93.00	32.50 - 33.00	4.618	.801	369.55	3.449	.176	225.48
1691	92.50 - 93.00	33.00 - 33.50	4.670	.761	341.76	3.728	.213	245.48
1692	92.50 - 93.00	33.50 - 34.00	4.670	.761	297.02	3.873	.279	238.33
1693	92.50 - 93.00	34.00 - 34.50	4.689	.747	270.42	3.892	.276	189.36
1694	92.50 - 93.00	34.50 - 35.00	4.701	.738	250.75	3.892	.276	88.15
1695	92.50 - 93.00	35.00 - 35.50	4.713	.728	248.89	3.892	.276	162.34
1696	92.50 - 93.00	35.50 - 36.00	4.718	.726	241.69	3.882	.284	164.18
1697	92.50 - 93.00	36.00 - 36.50	4.719	.724	233.39	3.882	.284	152.05
1698	92.50 - 93.00	36.50 - 37.00	4.744	.706	232.89	3.882	.284	139.75
1699	92.50 - 93.00	37.00 - 37.50	4.747	.705	233.56	3.882	.284	133.96
1700	92.50 - 93.00	37.50 - 38.00	4.750	.703	246.98	3.886	.278	140.09
1701	92.50 - 93.00	38.00 - 38.50	4.749	.704	263.11	3.886	.278	156.64
1702	92.50 - 93.00	38.50 - 39.00	4.749	.704	281.59	3.886	.278	180.07
1703	92.50 - 93.00	39.00 - 39.50	4.748	.704	302.72	3.876	.287	205.54
1704	92.50 - 93.00	39.50 - 40.00	4.709	.735	315.77	3.876	.287	233.64
1705	92.50 - 93.00	40.00 - 40.50	4.690	.748	339.33	3.815	.292	252.93
1706	92.50 - 93.00	40.50 - 41.00	4.676	.762	367.68	3.779	.306	277.85
1707	92.50 - 93.00	41.00 - 41.50	3.921	.218	197.76	3.671	.349	296.00
1708	92.50 - 93.00	41.50 - 42.00	3.918	.165	230.96	3.361	.404	309.71
1709	92.50 - 93.00	42.00 - 42.50	3.908	.165	244.97	2.621	.255	250.81
1710	92.50 - 93.00	42.50 - 43.00	3.798	.148	247.24	2.071	.000	193.19
1711	92.50 - 93.00	43.00 - 43.50	3.733	.161	241.34	2.071	.000	208.03
1712	92.50 - 93.00	43.50 - 44.00	3.629	.174	241.17	3.080	.559	301.92
1713	92.50 - 93.00	44.00 - 44.50	3.600	.157	241.49	3.080	.559	283.43
1714	92.50 - 93.00	44.50 - 45.00	3.533	.170	238.17	3.080	.559	263.86
1715	92.50 - 93.00	45.00 - 45.50	3.533	.170	234.40	3.080	.559	244.15

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1716	92.50 - 93.00	45.50 - 46.00	3.481	.174	219.70	3.080	.559	225.39
1717	92.50 - 93.00	46.00 - 46.50	3.430	.196	212.75	3.074	.553	212.72
1718	92.50 - 93.00	46.50 - 47.00	3.430	.196	217.94	3.074	.553	198.24
1719	92.50 - 93.00	47.00 - 47.50	3.307	.250	209.97	3.074	.553	189.02
1720	92.50 - 93.00	47.50 - 48.00	3.291	.275	223.54	3.074	.553	185.84
1721	92.50 - 93.00	48.00 - 48.50	3.291	.275	240.92	3.074	.553	189.02
1722	92.50 - 93.00	48.50 - 49.00	3.176	.353	239.43	3.074	.553	198.24
1723	92.50 - 93.00	49.00 - 49.50	3.176	.353	261.22	3.074	.553	212.72
1724	92.50 - 93.00	49.50 - 50.00	3.147	.394	282.43	3.074	.553	231.48
1725	93.00 - 93.50	28.00 - 28.50	2.989	.115	220.69	2.722	.255	89.12
1726	93.00 - 93.50	28.50 - 29.00	2.989	.115	195.37	2.722	.255	109.73
1727	93.00 - 93.50	29.00 - 29.50	2.989	.115	173.04	2.722	.255	127.05
1728	93.00 - 93.50	29.50 - 30.00	3.034	.054	156.98	2.722	.255	130.22
1729	93.00 - 93.50	30.00 - 30.50	3.259	.092	178.36	2.722	.255	113.20
1730	93.00 - 93.50	30.50 - 31.00	3.303	.097	172.43	2.839	.206	91.35
1731	93.00 - 93.50	31.00 - 31.50	3.617	.128	209.83	2.839	.206	64.96
1732	93.00 - 93.50	31.50 - 32.00	3.736	.146	208.86	3.207	.184	142.68
1733	93.00 - 93.50	32.00 - 32.50	3.790	.123	196.55	3.241	.164	191.22
1734	93.00 - 93.50	32.50 - 33.00	4.631	.791	382.97	3.449	.176	229.36
1735	93.00 - 93.50	33.00 - 33.50	4.680	.754	361.17	3.728	.213	255.81
1736	93.00 - 93.50	33.50 - 34.00	4.680	.754	320.60	3.834	.258	244.77
1737	93.00 - 93.50	34.00 - 34.50	4.698	.740	238.46	3.854	.257	206.75
1738	93.00 - 93.50	34.50 - 35.00	4.710	.732	281.03	3.854	.257	168.04
1739	93.00 - 93.50	35.00 - 35.50	4.721	.723	274.84	3.854	.257	180.04
1740	93.00 - 93.50	35.50 - 36.00	4.725	.721	269.94	3.843	.265	179.46
1741	93.00 - 93.50	36.00 - 36.50	4.726	.719	265.83	3.843	.265	170.71
1742	93.00 - 93.50	36.50 - 37.00	4.730	.717	264.75	3.882	.284	168.30
1743	93.00 - 93.50	37.00 - 37.50	4.734	.714	268.85	3.882	.284	165.09
1744	93.00 - 93.50	37.50 - 38.00	4.737	.711	278.31	3.886	.278	170.64
1745	93.00 - 93.50	38.00 - 38.50	4.736	.713	292.25	3.886	.278	184.00
1746	93.00 - 93.50	38.50 - 39.00	4.736	.713	309.06	3.886	.278	203.62
1747	93.00 - 93.50	39.00 - 39.50	4.735	.713	328.17	3.876	.287	226.10
1748	93.00 - 93.50	39.50 - 40.00	4.694	.745	338.44	3.876	.287	251.84
1749	93.00 - 93.50	40.00 - 40.50	4.675	.759	360.00	3.815	.292	269.29
1750	93.00 - 93.50	40.50 - 41.00	4.658	.775	385.00	3.779	.306	293.08

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1751	93.00 - 93.50	41.00 - 41.50	3.875	.204	202.79	3.671	.349	310.43
1752	93.00 - 93.50	41.50 - 42.00	3.840	.172	226.04	3.361	.404	326.65
1753	93.00 - 93.50	42.00 - 42.50	3.851	.172	240.01	2.621	.255	272.20
1754	93.00 - 93.50	42.50 - 43.00	3.753	.156	238.38	2.071	.000	217.40
1755	93.00 - 93.50	43.00 - 43.50	3.729	.167	241.14	2.071	.000	230.68
1756	93.00 - 93.50	43.50 - 44.00	3.629	.174	239.25	3.080	.559	316.40
1757	93.00 - 93.50	44.00 - 44.50	3.600	.157	239.07	3.080	.559	298.00
1758	93.00 - 93.50	44.50 - 45.00	3.533	.170	234.19	3.080	.559	279.18
1759	93.00 - 93.50	45.00 - 45.50	3.533	.170	227.43	3.080	.559	260.67
1760	93.00 - 93.50	45.50 - 46.00	3.481	.174	207.57	3.080	.559	243.40
1761	93.00 - 93.50	46.00 - 46.50	3.430	.196	196.12	3.074	.553	233.23
1762	93.00 - 93.50	46.50 - 47.00	3.430	.196	206.90	3.074	.553	220.10
1763	93.00 - 93.50	47.00 - 47.50	3.307	.250	207.92	3.074	.553	211.84
1764	93.00 - 93.50	47.50 - 48.00	3.291	.275	228.61	3.074	.553	209.01
1765	93.00 - 93.50	48.00 - 48.50	3.291	.275	249.87	3.074	.553	211.84
1766	93.00 - 93.50	48.50 - 49.00	3.176	.353	252.19	3.074	.553	220.10
1767	93.00 - 93.50	49.00 - 49.50	3.176	.353	274.59	3.074	.553	233.23
1768	93.00 - 93.50	49.50 - 50.00	3.147	.394	295.64	3.074	.553	250.46
1769	93.50 - 94.00	28.00 - 28.50	2.989	.115	228.27	2.722	.255	118.61
1770	93.50 - 94.00	28.50 - 29.00	2.989	.115	204.03	2.722	.255	129.86
1771	93.50 - 94.00	29.00 - 29.50	2.989	.115	182.20	2.722	.255	138.10
1772	93.50 - 94.00	29.50 - 30.00	3.034	.054	164.24	2.722	.255	133.30
1773	93.50 - 94.00	30.00 - 30.50	3.259	.092	181.70	2.722	.255	108.53
1774	93.50 - 94.00	30.50 - 31.00	3.303	.097	169.08	2.839	.206	73.70
1775	93.50 - 94.00	31.00 - 31.50	3.617	.128	200.78	2.839	.206	21.99
1776	93.50 - 94.00	31.50 - 32.00	3.749	.146	199.79	3.207	.184	118.58
1777	93.50 - 94.00	32.00 - 32.50	3.800	.129	190.75	3.241	.164	187.85
1778	93.50 - 94.00	32.50 - 33.00	4.633	.789	390.94	3.449	.176	237.20
1779	93.50 - 94.00	33.00 - 33.50	4.682	.753	375.30	3.727	.221	270.02
1780	93.50 - 94.00	33.50 - 34.00	4.682	.753	341.56	3.829	.265	264.49
1781	93.50 - 94.00	34.00 - 34.50	4.700	.739	311.81	3.849	.263	239.26
1782	93.50 - 94.00	34.50 - 35.00	4.711	.731	298.28	3.849	.263	217.68
1783	93.50 - 94.00	35.00 - 35.50	4.722	.722	278.50	3.849	.263	210.48
1784	93.50 - 94.00	35.50 - 36.00	4.726	.720	289.34	3.838	.272	203.69
1785	93.50 - 94.00	36.00 - 36.50	4.728	.719	294.28	3.838	.272	196.01

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
1786	93.50 - 94.00	36.50 - 37.00	4.732	.715	295.41	3.843	.265	190.12
1787	93.50 - 94.00	37.00 - 37.50	4.737	.712	300.46	3.843	.265	188.58
1788	93.50 - 94.00	37.50 - 38.00	4.740	.710	308.20	3.847	.259	193.81
1789	93.50 - 94.00	38.00 - 38.50	4.739	.711	319.73	3.847	.259	205.20
1790	93.50 - 94.00	38.50 - 39.00	4.739	.711	333.55	3.847	.259	222.13
1791	93.50 - 94.00	39.00 - 39.50	4.736	.713	348.87	3.836	.268	242.13
1792	93.50 - 94.00	39.50 - 40.00	4.696	.744	355.99	3.836	.268	265.75
1793	93.50 - 94.00	40.00 - 40.50	4.676	.758	373.93	3.768	.270	279.84
1794	93.50 - 94.00	40.50 - 41.00	4.660	.774	397.48	3.730	.285	302.54
1795	93.50 - 94.00	41.00 - 41.50	3.879	.208	205.80	3.612	.327	318.15
1796	93.50 - 94.00	41.50 - 42.00	3.840	.172	227.37	3.234	.372	325.99
1797	93.50 - 94.00	42.00 - 42.50	3.851	.172	240.13	2.621	.255	293.35
1798	93.50 - 94.00	42.50 - 43.00	3.753	.156	235.47	2.071	.000	241.92
1799	93.50 - 94.00	43.00 - 43.50	3.699	.161	233.33	2.446	.074	247.43
1800	93.50 - 94.00	43.50 - 44.00	3.623	.184	234.70	3.236	.414	367.14
1801	93.50 - 94.00	44.00 - 44.50	3.594	.167	235.17	3.236	.414	350.93
1802	93.50 - 94.00	44.50 - 45.00	3.525	.184	228.72	3.236	.414	335.02
1803	93.50 - 94.00	45.00 - 45.50	3.525	.184	217.47	3.236	.414	319.59
1804	93.50 - 94.00	45.50 - 46.00	3.472	.189	185.40	3.236	.414	305.16
1805	93.50 - 94.00	46.00 - 46.50	3.419	.213	161.51	3.230	.409	298.47
1806	93.50 - 94.00	46.50 - 47.00	3.419	.213	183.57	3.230	.409	287.30
1807	93.50 - 94.00	47.00 - 47.50	3.291	.275	199.13	3.230	.409	280.56
1808	93.50 - 94.00	47.50 - 48.00	3.271	.305	228.68	3.230	.409	279.01
1809	93.50 - 94.00	48.00 - 48.50	3.271	.305	255.29	3.074	.553	234.73
1810	93.50 - 94.00	48.50 - 49.00	3.176	.353	264.01	3.074	.553	242.22
1811	93.50 - 94.00	49.00 - 49.50	3.176	.353	287.57	3.074	.553	254.21
1812	93.50 - 94.00	49.50 - 50.00	3.147	.394	308.85	3.074	.553	270.10
1813	94.00 - 94.50	28.00 - 28.50	2.961	.155	236.60	2.722	.255	146.61
1814	94.00 - 94.50	28.50 - 29.00	2.961	.155	210.80	2.722	.255	150.95
1815	94.00 - 94.50	29.00 - 29.50	2.961	.155	186.57	2.722	.255	152.17
1816	94.00 - 94.50	29.50 - 30.00	3.013	.082	165.66	2.722	.255	142.69
1817	94.00 - 94.50	30.00 - 30.50	3.245	.111	178.24	2.722	.255	117.74
1818	94.00 - 94.50	30.50 - 31.00	3.328	.125	163.57	2.839	.206	92.68
1819	94.00 - 94.50	31.00 - 31.50	3.622	.143	183.04	2.839	.206	65.38
1820	94.00 - 94.50	31.50 - 32.00	3.751	.158	178.13	3.207	.184	146.00

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1821	94.00 - 94.50	32.00 - 32.50	3.798	.141	176.24	3.241	.164	201.38
1822	94.00 - 94.50	32.50 - 33.00	4.613	.806	388.70	3.449	.176	250.88
1823	94.00 - 94.50	33.00 - 33.50	4.623	.798	366.35	3.653	.191	270.68
1824	94.00 - 94.50	33.50 - 34.00	4.623	.798	337.13	3.728	.213	265.69
1825	94.00 - 94.50	34.00 - 34.50	4.646	.780	316.37	3.752	.215	248.95
1826	94.00 - 94.50	34.50 - 35.00	4.660	.771	293.56	3.752	.215	232.52
1827	94.00 - 94.50	35.00 - 35.50	4.673	.760	188.15	3.752	.215	222.31
1828	94.00 - 94.50	35.50 - 36.00	4.679	.757	293.21	3.740	.224	213.96
1829	94.00 - 94.50	36.00 - 36.50	4.680	.755	310.81	3.740	.224	207.31
1830	94.00 - 94.50	36.50 - 37.00	4.731	.716	323.55	3.838	.272	217.72
1831	94.00 - 94.50	37.00 - 37.50	4.735	.713	328.43	3.838	.272	217.10
1832	94.00 - 94.50	37.50 - 38.00	4.737	.712	334.98	3.843	.265	222.39
1833	94.00 - 94.50	38.00 - 38.50	4.736	.713	344.03	3.843	.265	232.49
1834	94.00 - 94.50	38.50 - 39.00	4.736	.713	353.88	3.843	.265	247.51
1835	94.00 - 94.50	39.00 - 39.50	4.733	.716	364.53	3.832	.274	265.79
1836	94.00 - 94.50	39.50 - 40.00	4.692	.747	366.00	3.843	.265	288.63
1837	94.00 - 94.50	40.00 - 40.50	4.672	.762	379.26	3.776	.268	300.30
1838	94.00 - 94.50	40.50 - 41.00	4.655	.778	402.59	3.739	.281	320.70
1839	94.00 - 94.50	41.00 - 41.50	3.872	.206	203.84	3.625	.321	333.88
1840	94.00 - 94.50	41.50 - 42.00	3.828	.173	223.47	3.285	.329	338.26
1841	94.00 - 94.50	42.00 - 42.50	3.840	.172	235.90	2.780	.175	294.23
1842	94.00 - 94.50	42.50 - 43.00	3.739	.155	227.70	2.446	.074	242.05
1843	94.00 - 94.50	43.00 - 43.50	3.654	.136	219.43	2.446	.074	241.15
1844	94.00 - 94.50	43.50 - 44.00	3.540	.154	211.82	3.236	.414	374.01
1845	94.00 - 94.50	44.00 - 44.50	3.475	.144	207.15	3.236	.414	359.47
1846	94.00 - 94.50	44.50 - 45.00	3.350	.151	188.87	3.236	.414	345.89
1847	94.00 - 94.50	45.00 - 45.50	3.350	.151	175.58	3.236	.414	333.16
1848	94.00 - 94.50	45.50 - 46.00	3.218	.203	115.36	3.236	.414	321.52
1849	94.00 - 94.50	46.00 - 46.50	3.135	.148	71.25	3.230	.409	318.16
1850	94.00 - 94.50	46.50 - 47.00	3.135	.148	109.91	3.230	.409	309.29
1851	94.00 - 94.50	47.00 - 47.50	2.972	.189	143.34	3.230	.409	304.20
1852	94.00 - 94.50	47.50 - 48.00	2.923	.238	182.22	3.230	.409	303.58
1853	94.00 - 94.50	48.00 - 48.50	2.923	.238	222.30	3.074	.553	257.68
1854	94.00 - 94.50	48.50 - 49.00	3.147	.394	271.99	3.074	.553	264.52
1855	94.00 - 94.50	49.00 - 49.50	3.147	.394	297.13	3.074	.553	275.54

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1856	94.00 - 94.50	49.50 - 50.00	3.147	.394	322.19	3.074	.553	290.26
1857	94.50 - 95.00	28.00 - 28.50	2.961	.155	241.53	2.722	.255	173.01
1858	94.50 - 95.00	28.50 - 29.00	2.961	.155	214.76	2.722	.255	172.48
1859	94.50 - 95.00	29.00 - 29.50	2.961	.155	188.51	2.722	.255	169.24
1860	94.50 - 95.00	29.50 - 30.00	3.013	.082	164.35	2.722	.255	158.44
1861	94.50 - 95.00	30.00 - 30.50	3.115	.087	146.23	2.722	.255	138.23
1862	94.50 - 95.00	30.50 - 31.00	3.207	.163	127.84	2.839	.206	128.87
1863	94.50 - 95.00	31.00 - 31.50	3.589	.128	147.54	2.839	.206	115.84
1864	94.50 - 95.00	31.50 - 32.00	3.706	.140	125.76	2.922	.187	141.69
1865	94.50 - 95.00	32.00 - 32.50	3.714	.131	133.03	2.898	.225	169.41
1866	94.50 - 95.00	32.50 - 33.00	3.749	.146	156.54	2.987	.184	197.94
1867	94.50 - 95.00	33.00 - 33.50	3.770	.151	156.01	3.395	.172	257.54
1868	94.50 - 95.00	33.50 - 34.00	3.770	.151	134.81	3.524	.209	269.07
1869	94.50 - 95.00	34.00 - 34.50	3.829	.177	119.74	3.524	.209	252.32
1870	94.50 - 95.00	34.50 - 35.00	3.867	.197	134.56	3.524	.209	237.93
1871	94.50 - 95.00	35.00 - 35.50	3.904	.206	134.25	3.524	.209	227.29
1872	94.50 - 95.00	35.50 - 36.00	3.918	.215	159.62	3.504	.224	217.55
1873	94.50 - 95.00	36.00 - 36.50	3.922	.212	178.08	3.504	.224	210.41
1874	94.50 - 95.00	36.50 - 37.00	4.680	.755	339.69	3.740	.224	229.89
1875	94.50 - 95.00	37.00 - 37.50	4.686	.751	345.54	3.740	.224	230.16
1876	94.50 - 95.00	37.50 - 38.00	4.688	.750	350.34	3.740	.224	234.96
1877	94.50 - 95.00	38.00 - 38.50	4.686	.751	354.97	3.740	.224	244.52
1878	94.50 - 95.00	38.50 - 39.00	4.682	.754	356.42	3.740	.224	258.53
1879	94.50 - 95.00	39.00 - 39.50	4.678	.756	357.78	3.727	.234	275.94
1880	94.50 - 95.00	39.50 - 40.00	4.621	.805	342.47	3.740	.224	297.14
1881	94.50 - 95.00	40.00 - 40.50	4.595	.823	335.82	3.646	.225	299.76
1882	94.50 - 95.00	40.50 - 41.00	4.577	.840	369.74	3.601	.232	318.58
1883	94.50 - 95.00	41.00 - 41.50	3.841	.158	200.27	3.457	.261	329.29
1884	94.50 - 95.00	41.50 - 42.00	3.801	.161	210.04	3.091	.285	334.39
1885	94.50 - 95.00	42.00 - 42.50	3.814	.162	221.94	2.722	.255	314.16
1886	94.50 - 95.00	42.50 - 43.00	3.704	.143	208.07	2.296	.225	234.88
1887	94.50 - 95.00	43.00 - 43.50	3.629	.145	201.28	2.446	.074	230.33
1888	94.50 - 95.00	43.50 - 44.00	3.506	.169	192.62	2.446	.074	231.06
1889	94.50 - 95.00	44.00 - 44.50	3.438	.155	190.98	2.446	.074	236.13
1890	94.50 - 95.00	44.50 - 45.00	3.302	.159	173.05	2.446	.074	245.53

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1891	94.50 - 95.00	45.00 - 45.50	3.302	.159	160.30	2.446	.074	258.93
1892	94.50 - 95.00	45.50 - 46.00	3.163	.189	94.18	2.446	.074	275.79
1893	94.50 - 95.00	46.00 - 46.50	3.117	.164	28.77	2.296	.225	283.13
1894	94.50 - 95.00	46.50 - 47.00	3.117	.164	93.06	2.296	.225	305.38
1895	94.50 - 95.00	47.00 - 47.50	2.923	.238	130.61	2.296	.225	329.74
1896	94.50 - 95.00	47.50 - 48.00	2.861	.300	170.24	2.296	.225	355.79
1897	94.50 - 95.00	48.00 - 48.50	2.861	.300	213.31	.000	.000	.00
1898	94.50 - 95.00	48.50 - 49.00	2.534	.149	190.57	3.074	.553	286.96
1899	94.50 - 95.00	49.00 - 49.50	2.534	.149	222.65	3.074	.553	297.15
1900	94.50 - 95.00	49.50 - 50.00	2.534	.149	253.88	3.074	.553	310.85
1901	95.00 - 95.50	27.00 - 27.50	2.534	.149	315.90	2.722	.255	212.30
1902	95.00 - 95.50	27.50 - 28.00	2.925	.205	280.64	2.722	.255	203.50
1903	95.00 - 95.50	28.00 - 28.50	2.961	.155	246.63	2.722	.255	198.44
1904	95.00 - 95.50	28.50 - 29.00	2.961	.155	218.70	2.722	.255	194.75
1905	95.00 - 95.50	29.00 - 29.50	2.961	.155	190.50	2.722	.255	189.19
1906	95.00 - 95.50	29.50 - 30.00	3.013	.082	163.73	2.722	.255	179.08
1907	95.00 - 95.50	30.00 - 30.50	3.115	.087	142.47	2.722	.255	164.35
1908	95.00 - 95.50	30.50 - 31.00	3.207	.163	119.54	2.839	.206	165.55
1909	95.00 - 95.50	31.00 - 31.50	3.448	.140	105.54	2.839	.206	158.73
1910	95.00 - 95.50	31.50 - 32.00	3.530	.146	44.26	2.839	.206	166.71
1911	95.00 - 95.50	32.00 - 32.50	3.545	.129	62.67	2.773	.225	175.69
1912	95.00 - 95.50	32.50 - 33.00	3.545	.129	118.00	2.773	.225	189.88
1913	95.00 - 95.50	33.00 - 33.50	3.589	.143	125.00	3.315	.170	272.65
1914	95.00 - 95.50	33.50 - 34.00	3.589	.143	95.55	3.447	.242	288.33
1915	95.00 - 95.50	34.00 - 34.50	3.641	.138	45.84	3.447	.242	274.05
1916	95.00 - 95.50	34.50 - 35.00	3.623	.133	103.64	3.447	.242	260.97
1917	95.00 - 95.50	35.00 - 35.50	3.688	.115	134.03	3.447	.242	250.33
1918	95.00 - 95.50	35.50 - 36.00	3.729	.125	155.85	3.421	.261	239.85
1919	95.00 - 95.50	36.00 - 36.50	3.703	.094	165.49	3.421	.261	232.45
1920	95.00 - 95.50	36.50 - 37.00	3.924	.211	189.35	3.504	.224	232.15
1921	95.00 - 95.50	37.00 - 37.50	3.939	.219	194.74	3.504	.224	231.85
1922	95.00 - 95.50	37.50 - 38.00	3.944	.221	194.17	3.504	.224	235.76
1923	95.00 - 95.50	38.00 - 38.50	3.940	.224	187.88	3.504	.224	244.09
1924	95.00 - 95.50	38.50 - 39.00	3.940	.224	172.73	3.504	.224	256.67
1925	95.00 - 95.50	39.00 - 39.50	3.931	.217	152.55	3.482	.241	272.00

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1926	95.00 - 95.50	39.50 - 40.00	3.937	.151	159.15	3.504	.224	291.44
1927	95.00 - 95.50	40.00 - 40.50	3.868	.149	98.08	3.482	.241	308.62
1928	95.00 - 95.50	40.50 - 41.00	3.860	.160	164.39	3.457	.261	327.11
1929	95.00 - 95.50	41.00 - 41.50	3.822	.149	184.65	3.405	.267	341.03
1930	95.00 - 95.50	41.50 - 42.00	3.793	.154	196.52	2.940	.316	319.80
1931	95.00 - 95.50	42.00 - 42.50	3.801	.161	206.00	2.296	.225	224.86
1932	95.00 - 95.50	42.50 - 43.00	3.704	.143	189.06	2.296	.225	211.21
1933	95.00 - 95.50	43.00 - 43.50	3.585	.124	169.72	2.296	.225	202.58
1934	95.00 - 95.50	43.50 - 44.00	3.448	.140	162.11	2.296	.225	199.62
1935	95.00 - 95.50	44.00 - 44.50	3.362	.137	162.35	2.296	.225	202.58
1936	95.00 - 95.50	44.50 - 45.00	3.179	.177	140.51	2.296	.225	211.21
1937	95.00 - 95.50	45.00 - 45.50	3.179	.177	135.06	2.296	.225	224.86
1938	95.00 - 95.50	45.50 - 46.00	3.185	.198	110.96	2.296	.225	242.68
1939	95.00 - 95.50	46.00 - 46.50	3.107	.178	68.54	2.296	.225	263.83
1940	95.00 - 95.50	46.50 - 47.00	3.107	.178	106.84	2.296	.225	287.57
1941	95.00 - 95.50	47.00 - 47.50	2.923	.238	134.53	2.296	.225	313.32
1942	95.00 - 95.50	47.50 - 48.00	2.861	.300	171.02	2.296	.225	340.63
1943	95.00 - 95.50	48.00 - 48.50	2.861	.300	212.41	.000	.000	.00
1944	95.00 - 95.50	48.50 - 49.00	2.384	.300	174.43	.000	.000	.00
1945	95.00 - 95.50	49.00 - 49.50	2.384	.300	208.61	.000	.000	.00
1946	95.00 - 95.50	49.50 - 50.00	2.384	.300	242.88	.000	.000	.00
1947	95.50 - 96.00	27.00 - 27.50	2.534	.149	338.96	2.722	.255	239.62
1948	95.50 - 96.00	27.50 - 28.00	2.925	.205	288.06	2.722	.255	230.23
1949	95.50 - 96.00	28.00 - 28.50	2.961	.155	252.68	2.722	.255	223.59
1950	95.50 - 96.00	28.50 - 29.00	2.961	.155	223.81	2.722	.255	218.03
1951	95.50 - 96.00	29.00 - 29.50	2.961	.155	194.23	2.722	.255	211.57
1952	95.50 - 96.00	29.50 - 30.00	3.013	.082	165.84	2.722	.255	202.90
1953	95.50 - 96.00	30.00 - 30.50	3.115	.087	143.05	2.722	.255	192.65
1954	95.50 - 96.00	30.50 - 31.00	3.207	.163	118.88	2.839	.206	199.64
1955	95.50 - 96.00	31.00 - 31.50	3.448	.140	108.91	2.839	.206	195.83
1956	95.50 - 96.00	31.50 - 32.00	3.530	.146	84.07	2.839	.206	200.97
1957	95.50 - 96.00	32.00 - 32.50	3.538	.137	99.20	2.597	.225	171.37
1958	95.50 - 96.00	32.50 - 33.00	3.538	.137	121.66	2.597	.225	181.75
1959	95.50 - 96.00	33.00 - 33.50	3.565	.139	118.48	3.251	.213	293.60
1960	95.50 - 96.00	33.50 - 34.00	3.571	.133	65.08	3.392	.285	311.06

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1961	95.50 - 96.00	34.00 - 34.50	3.571	.133	86.64	3.392	.285	298.63
1962	95.50 - 96.00	34.50 - 35.00	3.545	.129	102.18	3.392	.285	286.89
1963	95.50 - 96.00	35.00 - 35.50	3.623	.103	125.82	3.392	.285	276.86
1964	95.50 - 96.00	35.50 - 36.00	3.671	.112	143.56	3.358	.313	265.60
1965	95.50 - 96.00	36.00 - 36.50	3.639	.082	149.14	3.358	.313	258.18
1966	95.50 - 96.00	36.50 - 37.00	3.703	.094	169.58	3.421	.261	254.73
1967	95.50 - 96.00	37.00 - 37.50	3.743	.105	182.73	3.421	.261	254.27
1968	95.50 - 96.00	37.50 - 38.00	3.758	.106	182.97	3.421	.261	257.74
1969	95.50 - 96.00	38.00 - 38.50	3.749	.119	167.89	3.421	.261	265.33
1970	95.50 - 96.00	38.50 - 39.00	3.749	.119	137.09	3.421	.261	276.91
1971	95.50 - 96.00	39.00 - 39.50	3.723	.111	76.85	3.392	.285	290.34
1972	95.50 - 96.00	39.50 - 40.00	3.621	.074	94.27	3.421	.261	307.53
1973	95.50 - 96.00	40.00 - 40.50	3.595	.076	85.31	3.421	.261	324.34
1974	95.50 - 96.00	40.50 - 41.00	3.583	.093	109.66	3.392	.285	339.45
1975	95.50 - 96.00	41.00 - 41.50	3.583	.093	131.97	3.392	.285	356.01
1976	95.50 - 96.00	41.50 - 42.00	3.528	.105	136.66	2.896	.375	318.32
1977	95.50 - 96.00	42.00 - 42.50	3.547	.111	143.90	2.296	.225	203.09
1978	95.50 - 96.00	42.50 - 43.00	3.490	.082	128.33	2.296	.225	187.87
1979	95.50 - 96.00	43.00 - 43.50	3.605	.128	133.75	2.296	.225	178.11
1980	95.50 - 96.00	43.50 - 44.00	3.475	.144	142.09	2.296	.225	174.74
1981	95.50 - 96.00	44.00 - 44.50	3.391	.151	150.84	2.296	.225	178.11
1982	95.50 - 96.00	44.50 - 45.00	3.218	.203	135.53	2.296	.225	187.87
1983	95.50 - 96.00	45.00 - 45.50	3.218	.203	138.93	2.296	.225	203.09
1984	95.50 - 96.00	45.50 - 46.00	3.250	.212	142.12	2.296	.225	222.66
1985	95.50 - 96.00	46.00 - 46.50	3.185	.198	122.62	2.296	.225	245.54
1986	95.50 - 96.00	46.50 - 47.00	3.185	.198	146.24	2.296	.225	270.89
1987	95.50 - 96.00	47.00 - 47.50	3.034	.252	165.73	2.296	.225	298.09
1988	95.50 - 96.00	47.50 - 48.00	2.861	.300	176.83	2.296	.225	326.66
1989	95.50 - 96.00	48.00 - 48.50	2.861	.300	215.09	.000	.000	.00
1990	95.50 - 96.00	48.50 - 49.00	2.384	.300	179.26	.000	.000	.00
1991	95.50 - 96.00	49.00 - 49.50	2.384	.300	212.66	.000	.000	.00
1992	95.50 - 96.00	49.50 - 50.00	2.384	.300	246.37	.000	.000	.00
1993	96.00 - 96.50	25.00 - 25.50	.000	.000	.00	2.822	.367	271.80
1994	96.00 - 96.50	25.50 - 26.00	.000	.000	.00	2.822	.367	282.10
1995	96.00 - 96.50	26.00 - 26.50	.000	.000	.00	2.521	.367	265.47

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1996	96.00 - 96.50	26.50 - 27.00	.000	.000	.00	2.521	.367	254.01
1997	96.00 - 96.50	27.00 - 27.50	.000	.000	.00	2.722	.255	266.34
1998	96.00 - 96.50	27.50 - 28.00	2.735	.328	287.55	2.722	.255	256.51
1999	96.00 - 96.50	28.00 - 28.50	2.806	.230	251.16	2.722	.255	248.89
2000	96.00 - 96.50	28.50 - 29.00	2.806	.230	217.20	2.722	.255	242.38
2001	96.00 - 96.50	29.00 - 29.50	2.806	.230	183.41	2.722	.255	235.83
2002	96.00 - 96.50	29.50 - 30.00	2.890	.122	157.69	2.722	.255	228.68
2003	96.00 - 96.50	30.00 - 30.50	3.034	.054	140.18	2.722	.255	221.72
2004	96.00 - 96.50	30.50 - 31.00	3.151	.137	119.15	2.839	.206	231.40
2005	96.00 - 96.50	31.00 - 31.50	3.407	.154	106.86	2.839	.206	229.16
2006	96.00 - 96.50	31.50 - 32.00	3.500	.150	46.57	2.839	.206	232.79
2007	96.00 - 96.50	32.00 - 32.50	3.508	.139	106.91	2.597	.225	198.30
2008	96.00 - 96.50	32.50 - 33.00	3.508	.139	127.90	2.597	.225	205.46
2009	96.00 - 96.50	33.00 - 33.50	3.538	.137	125.68	2.597	.225	212.40
2010	96.00 - 96.50	33.50 - 34.00	3.545	.129	107.93	2.597	.225	218.32
2011	96.00 - 96.50	34.00 - 34.50	3.545	.129	106.44	2.597	.225	224.10
2012	96.00 - 96.50	34.50 - 35.00	3.545	.129	105.69	2.597	.225	231.49
2013	96.00 - 96.50	35.00 - 35.50	3.623	.103	115.02	2.597	.225	242.10
2014	96.00 - 96.50	35.50 - 36.00	3.671	.112	128.66	2.296	.225	210.32
2015	96.00 - 96.50	36.00 - 36.50	3.634	.089	135.49	2.296	.225	224.02
2016	96.00 - 96.50	36.50 - 37.00	3.709	.111	160.59	3.372	.293	278.10
2017	96.00 - 96.50	37.00 - 37.50	3.749	.119	176.68	3.372	.293	277.97
2018	96.00 - 96.50	37.50 - 38.00	3.749	.119	175.78	3.372	.293	281.43
2019	96.00 - 96.50	38.00 - 38.50	3.739	.132	158.13	3.372	.293	288.60
2020	96.00 - 96.50	38.50 - 39.00	3.739	.132	120.42	3.372	.293	299.41
2021	96.00 - 96.50	39.00 - 39.50	3.729	.125	83.39	3.333	.327	309.17
2022	96.00 - 96.50	39.50 - 40.00	3.556	.083	68.03	3.372	.293	325.05
2023	96.00 - 96.50	40.00 - 40.50	3.504	.063	42.41	3.358	.313	339.90
2024	96.00 - 96.50	40.50 - 41.00	3.497	.072	87.66	3.358	.313	353.49
2025	96.00 - 96.50	41.00 - 41.50	3.497	.072	103.09	3.358	.313	365.78
2026	96.00 - 96.50	41.50 - 42.00	3.463	.075	110.42	2.896	.375	313.53
2027	96.00 - 96.50	42.00 - 42.50	3.483	.092	115.88	2.296	.225	182.13
2028	96.00 - 96.50	42.50 - 43.00	3.483	.092	105.71	2.296	.225	164.99
2029	96.00 - 96.50	43.00 - 43.50	3.515	.092	65.14	2.896	.375	231.61
2030	96.00 - 96.50	43.50 - 44.00	3.410	.132	112.60	2.896	.375	231.33

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2C31	96.00 - 96.50	44.00 - 44.50	3.285	.214	117.27	2.896	.375	238.46
2C32	96.00 - 96.50	44.50 - 45.00	3.231	.196	126.17	2.896	.375	252.58
2C33	96.00 - 96.50	45.00 - 45.50	3.231	.196	137.15	2.896	.375	272.18
2C34	96.00 - 96.50	45.50 - 46.00	3.273	.189	159.25	2.896	.375	295.61
2C35	96.00 - 96.50	46.00 - 46.50	3.210	.172	154.00	2.896	.375	321.61
2C36	96.00 - 96.50	46.50 - 47.00	3.210	.172	173.48	2.896	.375	349.33
2C37	96.00 - 96.50	47.00 - 47.50	3.074	.212	186.85	2.296	.225	284.22
2C38	96.00 - 96.50	47.50 - 48.00	2.923	.238	196.76	2.296	.225	314.06
2C39	96.00 - 96.50	48.00 - 48.50	2.861	.300	220.37	.000	.000	.00
2C40	96.00 - 96.50	48.50 - 49.00	2.384	.300	187.03	.000	.000	.00
2C41	96.00 - 96.50	49.00 - 49.50	2.384	.300	219.25	.000	.000	.00
2C42	96.00 - 96.50	49.50 - 50.00	2.384	.300	252.08	.000	.000	.00
2C43	96.50 - 97.00	25.00 - 25.50	.000	.000	.00	2.521	.367	260.12
2C44	96.50 - 97.00	25.50 - 26.00	.000	.000	.00	2.521	.367	292.43
2C45	96.50 - 97.00	26.00 - 26.50	.000	.000	.00	2.521	.367	293.80
2C46	96.50 - 97.00	26.50 - 27.00	.000	.000	.00	2.521	.367	283.50
2C47	96.50 - 97.00	27.00 - 27.50	.000	.000	.00	2.722	.255	292.80
2C48	96.50 - 97.00	27.50 - 28.00	2.735	.328	292.30	2.722	.255	282.72
2C49	96.50 - 97.00	28.00 - 28.50	2.806	.230	256.68	2.722	.255	274.60
2C50	96.50 - 97.00	28.50 - 29.00	2.806	.230	223.46	2.722	.255	267.72
2C51	96.50 - 97.00	29.00 - 29.50	2.806	.230	190.62	2.722	.255	261.46
2C52	96.50 - 97.00	29.50 - 30.00	2.890	.122	166.11	2.722	.255	255.67
2C53	96.50 - 97.00	30.00 - 30.50	3.034	.054	150.51	2.722	.255	251.04
2C54	96.50 - 97.00	30.50 - 31.00	3.151	.137	132.71	2.839	.206	261.53
2C55	96.50 - 97.00	31.00 - 31.50	3.496	.182	146.53	2.839	.206	260.14
2C56	96.50 - 97.00	31.50 - 32.00	3.596	.169	124.61	2.881	.147	263.41
2C57	96.50 - 97.00	32.00 - 32.50	3.596	.169	142.97	2.685	.137	234.83
2C58	96.50 - 97.00	32.50 - 33.00	3.596	.169	154.02	2.685	.137	236.94
2C59	96.50 - 97.00	33.00 - 33.50	3.622	.162	150.73	2.685	.137	239.41
2C60	96.50 - 97.00	33.50 - 34.00	3.628	.154	137.42	2.685	.137	241.76
2C61	96.50 - 97.00	34.00 - 34.50	3.628	.154	123.33	2.685	.137	244.46
2C62	96.50 - 97.00	34.50 - 35.00	3.628	.154	105.05	2.685	.137	248.52
2C63	96.50 - 97.00	35.00 - 35.50	3.694	.132	95.53	2.685	.137	254.93
2C64	96.50 - 97.00	35.50 - 36.00	3.734	.139	111.09	2.446	.074	224.38
2C65	96.50 - 97.00	36.00 - 36.50	3.704	.118	126.43	2.446	.074	232.50

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2066	96.50 - 97.00	36.50 - 37.00	3.704	.118	146.84	2.446	.074	244.28
2067	96.50 - 97.00	37.00 - 37.50	3.744	.125	166.88	2.446	.074	259.26
2068	96.50 - 97.00	37.50 - 38.00	3.744	.125	168.96	2.446	.074	277.01
2069	96.50 - 97.00	38.00 - 38.50	3.734	.139	152.70	2.446	.074	297.06
2070	96.50 - 97.00	38.50 - 39.00	3.734	.139	109.18	2.940	.316	362.78
2071	96.50 - 97.00	39.00 - 39.50	3.724	.132	40.20	2.821	.411	345.75
2072	96.50 - 97.00	39.50 - 40.00	3.556	.083	40.24	2.940	.316	326.13
2073	96.50 - 97.00	40.00 - 40.50	3.504	.063	70.28	2.896	.375	304.50
2074	96.50 - 97.00	40.50 - 41.00	3.497	.072	84.20	2.896	.375	281.63
2075	96.50 - 97.00	41.00 - 41.50	3.497	.072	75.96	2.896	.375	260.70
2076	96.50 - 97.00	41.50 - 42.00	3.463	.075	93.32	2.896	.375	241.85
2077	96.50 - 97.00	42.00 - 42.50	3.483	.092	98.33	2.896	.375	225.33
2078	96.50 - 97.00	42.50 - 43.00	3.483	.092	81.05	2.896	.375	211.82
2079	96.50 - 97.00	43.00 - 43.50	3.490	.082	91.73	2.984	.309	210.83
2080	96.50 - 97.00	43.50 - 44.00	3.382	.115	102.73	2.984	.309	209.46
2081	96.50 - 97.00	44.00 - 44.50	3.254	.189	100.71	2.984	.309	216.84
2082	96.50 - 97.00	44.50 - 45.00	3.194	.169	109.17	2.984	.309	232.07
2083	96.50 - 97.00	45.00 - 45.50	3.194	.169	126.40	2.984	.309	252.74
2084	96.50 - 97.00	45.50 - 46.00	3.210	.172	152.59	2.984	.309	276.70
2085	96.50 - 97.00	46.00 - 46.50	3.210	.172	168.27	2.984	.309	302.68
2086	96.50 - 97.00	46.50 - 47.00	3.210	.172	188.96	2.984	.309	330.02
2087	96.50 - 97.00	47.00 - 47.50	3.074	.212	199.54	2.597	.225	309.95
2088	96.50 - 97.00	47.50 - 48.00	2.923	.238	206.07	2.597	.225	339.20
2089	96.50 - 97.00	48.00 - 48.50	2.861	.300	227.26	.000	.000	.00
2090	96.50 - 97.00	48.50 - 49.00	2.384	.300	197.39	.000	.000	.00
2091	96.50 - 97.00	49.00 - 49.50	2.384	.300	228.16	.000	.000	.00
2092	96.50 - 97.00	49.50 - 50.00	2.384	.300	259.86	.000	.000	.00
2093	97.00 - 97.50	25.00 - 25.50	.000	.000	.00	2.521	.367	273.59
2094	97.00 - 97.50	25.50 - 26.00	.000	.000	.00	2.521	.367	304.48
2095	97.00 - 97.50	26.00 - 26.50	.000	.000	.00	.000	.000	.00
2096	97.00 - 97.50	26.50 - 27.00	.000	.000	.00	.000	.000	.00
2097	97.00 - 97.50	27.00 - 27.50	.000	.000	.00	2.296	.225	344.82
2098	97.00 - 97.50	27.50 - 28.00	2.735	.328	299.94	2.296	.225	317.88
2099	97.00 - 97.50	28.00 - 28.50	2.806	.230	265.26	2.296	.225	292.53
2100	97.00 - 97.50	28.50 - 29.00	2.806	.230	233.17	2.296	.225	269.23

SEISMIC MAP OF CONTINENTAL U.S.

GFID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2101	97.00 - 97.50	29.00 - 29.50	2.806	.230	201.75	2.296	.225	248.54
2102	97.00 - 97.50	29.50 - 30.00	2.854	.167	174.63	2.296	.225	231.17
2103	97.00 - 97.50	30.00 - 30.50	3.013	.082	164.13	2.296	.225	217.91
2104	97.00 - 97.50	30.50 - 31.00	3.081	.115	143.74	2.597	.225	263.12
2105	97.00 - 97.50	31.00 - 31.50	3.455	.203	177.06	2.597	.225	255.45
2106	97.00 - 97.50	31.50 - 32.00	3.568	.178	170.98	2.685	.137	259.31
2107	97.00 - 97.50	32.00 - 32.50	3.568	.178	167.45	2.685	.137	256.87
2108	97.00 - 97.50	32.50 - 33.00	3.568	.178	164.53	2.685	.137	256.12
2109	97.00 - 97.50	33.00 - 33.50	3.588	.179	155.86	2.685	.137	256.05
2110	97.00 - 97.50	33.50 - 34.00	3.596	.169	139.54	2.685	.137	256.30
2111	97.00 - 97.50	34.00 - 34.50	3.596	.169	117.21	2.685	.137	257.16
2112	97.00 - 97.50	34.50 - 35.00	3.596	.169	85.70	2.685	.137	259.35
2113	97.00 - 97.50	35.00 - 35.50	3.666	.146	46.96	2.685	.137	263.76
2114	97.00 - 97.50	35.50 - 36.00	3.708	.154	75.44	2.446	.074	228.86
2115	97.00 - 97.50	36.00 - 36.50	3.678	.130	101.52	2.446	.074	235.36
2116	97.00 - 97.50	36.50 - 37.00	3.699	.125	133.42	2.534	.014	232.01
2117	97.00 - 97.50	37.00 - 37.50	3.739	.132	157.28	2.534	.014	240.25
2118	97.00 - 97.50	37.50 - 38.00	3.739	.132	163.82	2.534	.014	250.91
2119	97.00 - 97.50	38.00 - 38.50	3.729	.147	154.24	2.534	.014	263.79
2120	97.00 - 97.50	38.50 - 39.00	3.729	.147	123.33	2.972	.280	330.47
2121	97.00 - 97.50	39.00 - 39.50	3.719	.139	88.66	2.865	.367	309.09
2122	97.00 - 97.50	39.50 - 40.00	3.550	.089	75.07	3.040	.237	302.11
2123	97.00 - 97.50	40.00 - 40.50	3.497	.072	86.70	3.016	.266	287.73
2124	97.00 - 97.50	40.50 - 41.00	3.497	.072	83.24	3.016	.266	267.65
2125	97.00 - 97.50	41.00 - 41.50	3.497	.072	35.16	3.016	.266	248.40
2126	97.00 - 97.50	41.50 - 42.00	3.463	.075	83.33	3.016	.266	230.27
2127	97.00 - 97.50	42.00 - 42.50	3.483	.092	85.88	2.984	.309	209.07
2128	97.00 - 97.50	42.50 - 43.00	3.483	.092	40.84	2.984	.309	193.41
2129	97.00 - 97.50	43.00 - 43.50	3.483	.092	86.99	2.984	.309	181.97
2130	97.00 - 97.50	43.50 - 44.00	3.372	.125	93.09	2.984	.309	179.02
2131	97.00 - 97.50	44.00 - 44.50	3.243	.192	81.50	2.984	.309	187.80
2132	97.00 - 97.50	44.50 - 45.00	3.194	.169	93.16	2.984	.309	206.37
2133	97.00 - 97.50	45.00 - 45.50	3.194	.169	118.14	2.984	.309	230.43
2134	97.00 - 97.50	45.50 - 46.00	3.210	.172	152.05	2.984	.309	257.10
2135	97.00 - 97.50	46.00 - 46.50	3.210	.172	174.90	2.984	.309	285.13

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
2136	97.00 - 97.50	46.50 - 47.00	3.210	.172	198.51	2.984	.309	314.07
2137	97.00 - 97.50	47.00 - 47.50	3.074	.212	209.58	2.597	.225	296.60
2138	97.00 - 97.50	47.50 - 48.00	2.923	.238	215.14	2.597	.225	326.90
2139	97.00 - 97.50	48.00 - 48.50	2.861	.300	235.03	.000	.000	.00
2140	97.00 - 97.50	48.50 - 49.00	2.384	.300	209.96	.000	.000	.00
2141	97.00 - 97.50	49.00 - 49.50	2.384	.300	239.12	.000	.000	.00
2142	97.00 - 97.50	49.50 - 50.00	2.384	.300	269.54	.000	.000	.00
2143	97.50 - 98.00	25.00 - 25.50	.000	.000	.00	2.521	.367	289.99
2144	97.50 - 98.00	25.50 - 26.00	.000	.000	.00	2.521	.367	319.29
2145	97.50 - 98.00	26.00 - 26.50	.000	.000	.00	.000	.000	.00
2146	97.50 - 98.00	26.50 - 27.00	.000	.000	.00	.000	.000	.00
2147	97.50 - 98.00	27.00 - 27.50	.000	.000	.00	2.296	.225	363.25
2148	97.50 - 98.00	27.50 - 28.00	2.735	.328	310.27	2.296	.225	337.78
2149	97.50 - 98.00	28.00 - 28.50	2.806	.230	276.66	2.296	.225	314.04
2150	97.50 - 98.00	28.50 - 29.00	2.806	.230	245.97	2.296	.225	292.46
2151	97.50 - 98.00	29.00 - 29.50	2.806	.230	216.31	2.296	.225	273.53
2152	97.50 - 98.00	29.50 - 30.00	2.854	.167	190.84	2.296	.225	257.85
2153	97.50 - 98.00	30.00 - 30.50	3.013	.082	183.11	2.296	.225	246.04
2154	97.50 - 98.00	30.50 - 31.00	3.081	.115	166.09	2.296	.225	238.67
2155	97.50 - 98.00	31.00 - 31.50	3.455	.203	207.35	2.296	.225	236.17
2156	97.50 - 98.00	31.50 - 32.00	3.568	.178	200.24	2.446	.074	246.32
2157	97.50 - 98.00	32.00 - 32.50	3.568	.178	188.04	2.446	.074	246.05
2158	97.50 - 98.00	32.50 - 33.00	3.568	.178	176.24	2.446	.074	247.24
2159	97.50 - 98.00	33.00 - 33.50	3.588	.179	162.13	2.446	.074	248.65
2160	97.50 - 98.00	33.50 - 34.00	3.596	.169	141.28	2.534	.014	248.99
2161	97.50 - 98.00	34.00 - 34.50	3.596	.169	113.93	2.534	.014	245.61
2162	97.50 - 98.00	34.50 - 35.00	3.596	.169	79.49	2.534	.014	241.94
2163	97.50 - 98.00	35.00 - 35.50	3.666	.146	38.16	2.534	.014	239.16
2164	97.50 - 98.00	35.50 - 36.00	3.708	.154	36.94	2.372	.000	229.29
2165	97.50 - 98.00	36.00 - 36.50	3.678	.130	85.81	2.372	.000	226.72
2166	97.50 - 98.00	36.50 - 37.00	3.688	.140	121.94	2.534	.014	223.19
2167	97.50 - 98.00	37.00 - 37.50	3.729	.147	144.67	2.534	.014	230.65
2168	97.50 - 98.00	37.50 - 38.00	3.729	.147	156.71	2.534	.014	240.75
2169	97.50 - 98.00	38.00 - 38.50	3.724	.154	158.72	2.534	.014	253.33
2170	97.50 - 98.00	38.50 - 39.00	3.724	.154	145.12	2.972	.280	317.03

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
2171	97.50 - 98.00	39.00 - 39.50	3.729	.147	131.18	2.865	.367	291.16
2172	97.50 - 98.00	39.50 - 40.00	3.565	.109	107.13	3.040	.237	286.33
2173	97.50 - 98.00	40.00 - 40.50	3.515	.092	106.80	3.016	.266	270.85
2174	97.50 - 98.00	40.50 - 41.00	3.490	.082	96.31	3.016	.266	249.83
2175	97.50 - 98.00	41.00 - 41.50	3.490	.082	77.54	3.016	.266	229.44
2176	97.50 - 98.00	41.50 - 42.00	3.463	.075	92.67	3.016	.266	209.98
2177	97.50 - 98.00	42.00 - 42.50	3.483	.092	87.31	2.984	.309	186.89
2178	97.50 - 98.00	42.50 - 43.00	3.483	.092	41.01	2.984	.309	168.23
2179	97.50 - 98.00	43.00 - 43.50	3.515	.092	90.06	3.016	.266	154.90
2180	97.50 - 98.00	43.50 - 44.00	3.410	.132	84.48	3.016	.266	148.91
2181	97.50 - 98.00	44.00 - 44.50	3.285	.214	55.34	3.016	.266	159.87
2182	97.50 - 98.00	44.50 - 45.00	3.243	.192	79.16	3.016	.266	182.71
2183	97.50 - 98.00	45.00 - 45.50	3.243	.192	115.40	3.016	.266	209.59
2184	97.50 - 98.00	45.50 - 46.00	3.294	.168	163.49	3.016	.266	237.37
2185	97.50 - 98.00	46.00 - 46.50	3.294	.168	192.49	3.016	.266	265.49
2186	97.50 - 98.00	46.50 - 47.00	3.294	.168	219.74	3.016	.266	294.00
2187	97.50 - 98.00	47.00 - 47.50	3.107	.178	221.90	2.685	.137	285.01
2188	97.50 - 98.00	47.50 - 48.00	2.972	.189	231.47	2.685	.137	313.74
2189	97.50 - 98.00	48.00 - 48.50	2.861	.300	243.33	2.071	.000	387.52
2190	97.50 - 98.00	48.50 - 49.00	2.384	.300	224.38	.000	.000	.00
2191	97.50 - 98.00	49.00 - 49.50	2.384	.300	251.87	.000	.000	.00
2192	97.50 - 98.00	49.50 - 50.00	2.384	.300	280.91	.000	.000	.00
2193	98.00 - 98.50	25.00 - 25.50	.000	.000	.00	2.521	.367	308.85
2194	98.00 - 98.50	25.50 - 26.00	.000	.000	.00	2.521	.367	336.51
2195	98.00 - 98.50	26.00 - 26.50	.000	.000	.00	2.296	.225	284.71
2196	98.00 - 98.50	26.50 - 27.00	.000	.000	.00	2.296	.225	278.37
2197	98.00 - 98.50	27.00 - 27.50	.000	.000	.00	2.597	.225	318.61
2198	98.00 - 98.50	27.50 - 28.00	2.735	.328	323.08	2.597	.225	312.16
2199	98.00 - 98.50	28.00 - 28.50	2.806	.230	290.58	2.597	.225	307.93
2200	98.00 - 98.50	28.50 - 29.00	2.806	.230	261.48	2.597	.225	305.34
2201	98.00 - 98.50	29.00 - 29.50	2.806	.230	233.74	2.597	.225	303.95
2202	98.00 - 98.50	29.50 - 30.00	2.854	.167	209.80	2.597	.225	303.64
2203	98.00 - 98.50	30.00 - 30.50	2.989	.115	202.55	2.597	.225	304.64
2204	98.00 - 98.50	30.50 - 31.00	3.061	.137	187.34	2.597	.225	307.54
2205	98.00 - 98.50	31.00 - 31.50	3.443	.220	230.73	2.597	.225	312.97

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
2206	98.00 - 98.50	31.50 - 32.00	3.559	.190	219.69	2.446	.074	264.14
2207	98.00 - 98.50	32.00 - 32.50	3.580	.190	205.78	2.446	.074	260.38
2208	98.00 - 98.50	32.50 - 33.00	3.580	.190	188.45	2.446	.074	257.06
2209	98.00 - 98.50	33.00 - 33.50	3.600	.191	169.80	2.446	.074	253.14
2210	98.00 - 98.50	33.50 - 34.00	3.607	.181	144.60	2.534	.014	245.54
2211	98.00 - 98.50	34.00 - 34.50	3.607	.181	112.23	2.534	.014	236.88
2212	98.00 - 98.50	34.50 - 35.00	3.607	.181	80.66	2.534	.014	228.36
2213	98.00 - 98.50	35.00 - 35.50	3.677	.156	69.46	2.534	.014	221.69
2214	98.00 - 98.50	35.50 - 36.00	3.718	.162	43.57	2.372	.000	201.29
2215	98.00 - 98.50	36.00 - 36.50	3.688	.140	89.11	2.372	.000	199.23
2216	98.00 - 98.50	36.50 - 37.00	3.704	.143	117.20	2.548	.000	221.43
2217	98.00 - 98.50	37.00 - 37.50	3.744	.147	121.58	2.548	.000	228.04
2218	98.00 - 98.50	37.50 - 38.00	3.744	.147	148.03	2.548	.000	237.92
2219	98.00 - 98.50	38.00 - 38.50	3.739	.155	164.89	2.548	.000	250.92
2220	98.00 - 98.50	38.50 - 39.00	3.753	.156	166.25	2.896	.343	273.85
2221	98.00 - 98.50	39.00 - 39.50	3.758	.149	161.49	2.896	.343	268.17
2222	98.00 - 98.50	39.50 - 40.00	3.607	.129	134.40	3.060	.216	268.34
2223	98.00 - 98.50	40.00 - 40.50	3.544	.096	127.29	3.060	.216	252.90
2224	98.00 - 98.50	40.50 - 41.00	3.522	.083	120.10	3.040	.237	232.43
2225	98.00 - 98.50	41.00 - 41.50	3.522	.083	114.35	3.040	.237	211.31
2226	98.00 - 98.50	41.50 - 42.00	3.497	.072	113.34	3.040	.237	191.09
2227	98.00 - 98.50	42.00 - 42.50	3.515	.092	106.14	3.016	.266	168.82
2228	98.00 - 98.50	42.50 - 43.00	3.515	.092	86.96	3.016	.266	147.46
2229	98.00 - 98.50	43.00 - 43.50	3.522	.083	102.33	3.016	.266	124.49
2230	98.00 - 98.50	43.50 - 44.00	3.419	.125	78.22	3.016	.266	112.06
2231	98.00 - 98.50	44.00 - 44.50	3.294	.213	23.64	3.016	.266	128.80
2232	98.00 - 98.50	44.50 - 45.00	3.254	.189	69.64	3.016	.266	159.87
2233	98.00 - 98.50	45.00 - 45.50	3.254	.189	112.87	3.016	.266	191.42
2234	98.00 - 98.50	45.50 - 46.00	3.312	.149	165.00	3.016	.266	221.67
2235	98.00 - 98.50	46.00 - 46.50	3.312	.149	196.35	3.016	.266	251.32
2236	98.00 - 98.50	46.50 - 47.00	3.312	.149	225.00	3.016	.266	280.96
2237	98.00 - 98.50	47.00 - 47.50	3.136	.149	230.51	2.685	.137	273.93
2238	98.00 - 98.50	47.50 - 48.00	3.011	.149	242.58	2.685	.137	303.34
2239	98.00 - 98.50	48.00 - 48.50	2.923	.238	262.10	2.071	.000	370.60
2240	98.00 - 98.50	48.50 - 49.00	2.384	.300	240.30	.000	.000	.00

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
2241	98.00 - 98.50	49.00 - 49.50	2.384	.300	266.15	.000	.000	.00
2242	98.00 - 98.50	49.50 - 50.00	2.384	.300	293.79	.000	.000	.00
2243	98.50 - 99.00	25.00 - 25.50	.000	.000	.00	2.722	.255	308.60
2244	98.50 - 99.00	25.50 - 26.00	.000	.000	.00	2.722	.255	313.52
2245	98.50 - 99.00	26.00 - 26.50	.000	.000	.00	2.296	.225	255.08
2246	98.50 - 99.00	26.50 - 27.00	.000	.000	.00	2.296	.225	247.98
2247	98.50 - 99.00	27.00 - 27.50	.000	.000	.00	2.296	.225	245.57
2248	98.50 - 99.00	27.50 - 28.00	2.735	.328	338.09	2.296	.225	247.98
2249	98.50 - 99.00	28.00 - 28.50	2.806	.230	306.70	2.296	.225	255.08
2250	98.50 - 99.00	28.50 - 29.00	2.806	.230	279.26	2.296	.225	266.49
2251	98.50 - 99.00	29.00 - 29.50	2.806	.230	253.46	2.296	.225	281.69
2252	98.50 - 99.00	29.50 - 30.00	2.854	.167	230.76	2.296	.225	300.10
2253	98.50 - 99.00	30.00 - 30.50	2.989	.115	225.17	2.296	.225	321.18
2254	98.50 - 99.00	30.50 - 31.00	3.061	.137	209.62	2.296	.225	344.42
2255	98.50 - 99.00	31.00 - 31.50	3.443	.220	250.79	2.296	.225	369.43
2256	98.50 - 99.00	31.50 - 32.00	3.580	.190	237.50	2.071	.000	309.64
2257	98.50 - 99.00	32.00 - 32.50	3.600	.191	219.95	2.372	.000	317.50
2258	98.50 - 99.00	32.50 - 33.00	3.600	.191	199.36	2.372	.000	288.85
2259	98.50 - 99.00	33.00 - 33.50	3.618	.193	177.61	2.372	.000	261.48
2260	98.50 - 99.00	33.50 - 34.00	3.625	.183	150.39	2.548	.000	260.06
2261	98.50 - 99.00	34.00 - 34.50	3.625	.183	112.41	2.548	.000	235.73
2262	98.50 - 99.00	34.50 - 35.00	3.625	.183	51.15	2.548	.000	215.15
2263	98.50 - 99.00	35.00 - 35.50	3.693	.158	90.82	2.548	.000	199.99
2264	98.50 - 99.00	35.50 - 36.00	3.733	.162	91.21	2.548	.000	191.67
2265	98.50 - 99.00	36.00 - 36.50	3.704	.143	107.37	2.548	.000	190.27
2266	98.50 - 99.00	36.50 - 37.00	3.698	.150	114.67	2.548	.000	194.35
2267	98.50 - 99.00	37.00 - 37.50	3.739	.155	63.24	2.548	.000	202.17
2268	98.50 - 99.00	37.50 - 38.00	3.739	.155	138.34	2.548	.000	212.92
2269	98.50 - 99.00	38.00 - 38.50	3.733	.162	167.42	2.548	.000	226.74
2270	98.50 - 99.00	38.50 - 39.00	3.753	.156	177.10	2.896	.343	256.80
2271	98.50 - 99.00	39.00 - 39.50	3.758	.149	175.83	2.896	.343	252.23
2272	98.50 - 99.00	39.50 - 40.00	3.607	.129	146.15	3.060	.216	254.69
2273	98.50 - 99.00	40.00 - 40.50	3.550	.089	140.87	3.060	.216	238.66
2274	98.50 - 99.00	40.50 - 41.00	3.528	.075	137.81	3.040	.237	217.05
2275	98.50 - 99.00	41.00 - 41.50	3.528	.075	135.72	3.040	.237	194.76

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2276	98.50 - 99.00	41.50 - 42.00	3.504	.063	130.55	3.040	.237	173.56
2277	98.50 - 99.00	42.00 - 42.50	3.522	.083	126.35	3.016	.266	150.60
2278	98.50 - 99.00	42.50 - 43.00	3.522	.083	118.54	3.016	.266	127.73
2279	98.50 - 99.00	43.00 - 43.50	3.522	.083	117.94	3.115	.221	107.73
2280	98.50 - 99.00	43.50 - 44.00	3.419	.125	90.19	3.071	.238	72.76
2281	98.50 - 99.00	44.00 - 44.50	3.294	.213	56.46	3.071	.238	106.17
2282	98.50 - 99.00	44.50 - 45.00	3.254	.189	80.39	3.016	.266	141.36
2283	98.50 - 99.00	45.00 - 45.50	3.254	.189	116.95	3.016	.266	176.68
2284	98.50 - 99.00	45.50 - 46.00	3.312	.149	167.97	3.016	.266	208.50
2285	98.50 - 99.00	46.00 - 46.50	3.312	.149	199.44	3.016	.266	239.14
2286	98.50 - 99.00	46.50 - 47.00	3.312	.149	228.63	3.016	.266	269.61
2287	98.50 - 99.00	47.00 - 47.50	3.136	.149	235.19	2.685	.137	264.41
2288	98.50 - 99.00	47.50 - 48.00	3.011	.149	248.48	2.685	.137	294.34
2289	98.50 - 99.00	48.00 - 48.50	2.923	.238	269.96	2.071	.000	354.60
2290	98.50 - 99.00	48.50 - 49.00	2.736	.300	185.22	.000	.000	.00
2291	98.50 - 99.00	49.00 - 49.50	2.736	.300	190.62	.000	.000	.00
2292	98.50 - 99.00	49.50 - 50.00	2.736	.300	198.07	.000	.000	.00
2293	99.00 - 99.50	25.00 - 25.50	.000	.000	.00	2.722	.255	305.54
2294	99.00 - 99.50	25.50 - 26.00	.000	.000	.00	2.722	.255	304.42
2295	99.00 - 99.50	26.00 - 26.50	.000	.000	.00	2.296	.225	225.73
2296	99.00 - 99.50	26.50 - 27.00	.000	.000	.00	2.296	.225	217.68
2297	99.00 - 99.50	27.00 - 27.50	.000	.000	.00	2.296	.225	214.93
2298	99.00 - 99.50	27.50 - 28.00	2.735	.328	355.05	2.296	.225	217.68
2299	99.00 - 99.50	28.00 - 28.50	2.806	.230	324.70	2.296	.225	225.73
2300	99.00 - 99.50	28.50 - 29.00	2.806	.230	298.91	2.296	.225	238.55
2301	99.00 - 99.50	29.00 - 29.50	2.806	.230	274.99	2.296	.225	255.42
2302	99.00 - 99.50	29.50 - 30.00	2.854	.167	253.16	2.296	.225	275.59
2303	99.00 - 99.50	30.00 - 30.50	2.989	.115	248.52	2.296	.225	298.40
2304	99.00 - 99.50	30.50 - 31.00	3.061	.137	231.35	2.296	.225	323.29
2305	99.00 - 99.50	31.00 - 31.50	3.382	.189	254.18	2.296	.225	349.82
2306	99.00 - 99.50	31.50 - 32.00	3.527	.182	237.07	2.071	.000	298.03
2307	99.00 - 99.50	32.00 - 32.50	3.547	.187	217.65	2.372	.000	302.53
2308	99.00 - 99.50	32.50 - 33.00	3.547	.187	196.08	2.372	.000	272.30
2309	99.00 - 99.50	33.00 - 33.50	3.566	.193	174.13	2.372	.000	243.01
2310	99.00 - 99.50	33.50 - 34.00	3.574	.184	148.80	2.548	.000	239.53

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2311	99.00 - 99.50	34.00 - 34.50	3.574	.184	118.97	2.548	.000	212.29
2312	99.00 - 99.50	34.50 - 35.00	3.574	.184	93.82	2.548	.000	188.52
2313	99.00 - 99.50	35.00 - 35.50	3.651	.151	106.95	2.548	.000	170.70
2314	99.00 - 99.50	35.50 - 36.00	3.698	.150	116.71	2.548	.000	161.55
2315	99.00 - 99.50	36.00 - 36.50	3.663	.137	119.44	2.548	.000	161.54
2316	99.00 - 99.50	36.50 - 37.00	3.698	.150	127.85	2.962	.034	200.81
2317	99.00 - 99.50	37.00 - 37.50	3.739	.155	123.31	2.962	.034	203.50
2318	99.00 - 99.50	37.50 - 38.00	3.739	.155	148.15	2.962	.034	207.64
2319	99.00 - 99.50	38.00 - 38.50	3.733	.162	171.57	2.962	.034	213.54
2320	99.00 - 99.50	38.50 - 39.00	3.753	.156	184.32	3.197	.167	255.75
2321	99.00 - 99.50	39.00 - 39.50	3.758	.149	179.24	3.197	.167	255.32
2322	99.00 - 99.50	39.50 - 40.00	3.607	.129	135.77	3.266	.126	249.26
2323	99.00 - 99.50	40.00 - 40.50	3.550	.089	145.52	3.266	.126	240.14
2324	99.00 - 99.50	40.50 - 41.00	3.528	.075	150.94	3.254	.144	226.03
2325	99.00 - 99.50	41.00 - 41.50	3.528	.075	151.02	3.241	.164	207.40
2326	99.00 - 99.50	41.50 - 42.00	3.504	.063	144.89	3.132	.202	166.05
2327	99.00 - 99.50	42.00 - 42.50	3.522	.083	142.05	3.115	.221	146.03
2328	99.00 - 99.50	42.50 - 43.00	3.522	.083	135.84	3.115	.221	125.45
2329	99.00 - 99.50	43.00 - 43.50	3.522	.083	131.57	3.935	.240	227.40
2330	99.00 - 99.50	43.50 - 44.00	3.419	.125	109.27	3.927	.245	99.52
2331	99.00 - 99.50	44.00 - 44.50	3.294	.213	88.50	3.266	.310	115.73
2332	99.00 - 99.50	44.50 - 45.00	3.292	.219	102.16	3.016	.266	130.30
2333	99.00 - 99.50	45.00 - 45.50	3.292	.219	126.64	3.016	.266	166.00
2334	99.00 - 99.50	45.50 - 46.00	3.375	.169	176.04	3.016	.266	197.98
2335	99.00 - 99.50	46.00 - 46.50	3.375	.169	200.00	3.016	.266	229.00
2336	99.00 - 99.50	46.50 - 47.00	3.375	.169	220.35	3.016	.266	259.99
2337	99.00 - 99.50	47.00 - 47.50	3.227	.177	216.86	2.685	.137	256.42
2338	99.00 - 99.50	47.50 - 48.00	3.128	.184	215.80	2.685	.137	286.75
2339	99.00 - 99.50	48.00 - 48.50	3.058	.254	216.61	2.071	.000	339.65
2340	99.00 - 99.50	48.50 - 49.00	3.082	.490	187.54	.000	.000	.00
2341	99.00 - 99.50	49.00 - 49.50	3.082	.490	186.06	.000	.000	.00
2342	99.00 - 99.50	49.50 - 50.00	3.082	.490	186.82	.000	.000	.00
2343	99.50 - 100.00	25.00 - 25.50	.000	.000	.00	2.296	.225	230.24
2344	99.50 - 100.00	25.50 - 26.00	.000	.000	.00	2.296	.225	211.37
2345	99.50 - 100.00	26.00 - 26.50	.000	.000	.00	2.597	.225	240.43

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	B(N)	R(N)
2346	99.50 - 100.00	26.50 - 27.00	2.819	.511	217.95	2.597	.225	228.64
2347	99.50 - 100.00	27.00 - 27.50	2.819	.511	204.34	2.597	.225	222.60
2348	99.50 - 100.00	27.50 - 28.00	3.126	.364	255.99	2.597	.225	222.41
2349	99.50 - 100.00	28.00 - 28.50	3.155	.325	243.83	2.597	.225	227.51
2350	99.50 - 100.00	28.50 - 29.00	3.155	.325	229.52	2.597	.225	236.96
2351	99.50 - 100.00	29.00 - 29.50	3.155	.325	217.31	2.597	.225	249.91
2352	99.50 - 100.00	29.50 - 30.00	3.177	.296	209.53	2.597	.225	265.73
2353	99.50 - 100.00	30.00 - 30.50	3.255	.230	215.04	2.597	.225	284.04
2354	99.50 - 100.00	30.50 - 31.00	3.299	.205	212.13	2.597	.225	304.56
2355	99.50 - 100.00	31.00 - 31.50	3.484	.178	226.05	2.597	.225	327.05
2356	99.50 - 100.00	31.50 - 32.00	3.584	.151	217.02	2.446	.074	295.45
2357	99.50 - 100.00	32.00 - 32.50	3.598	.154	204.83	2.534	.014	273.68
2358	99.50 - 100.00	32.50 - 33.00	3.598	.154	190.57	2.597	.076	253.48
2359	99.50 - 100.00	33.00 - 33.50	3.611	.157	174.06	2.722	.187	251.04
2360	99.50 - 100.00	33.50 - 34.00	3.617	.150	154.90	2.754	.184	217.38
2361	99.50 - 100.00	34.00 - 34.50	3.617	.150	134.52	2.754	.184	193.12
2362	99.50 - 100.00	34.50 - 35.00	3.617	.150	118.94	2.754	.184	170.14
2363	99.50 - 100.00	35.00 - 35.50	3.651	.151	121.11	2.881	.065	172.61
2364	99.50 - 100.00	35.50 - 36.00	3.698	.150	129.80	2.881	.065	160.77
2365	99.50 - 100.00	36.00 - 36.50	3.663	.137	130.39	2.962	.034	172.60
2366	99.50 - 100.00	36.50 - 37.00	3.664	.136	134.31	3.899	.227	305.94
2367	99.50 - 100.00	37.00 - 37.50	3.710	.134	141.18	3.899	.227	294.16
2368	99.50 - 100.00	37.50 - 38.00	3.710	.134	139.30	3.899	.227	283.35
2369	99.50 - 100.00	38.00 - 38.50	3.705	.141	164.26	3.899	.227	274.53
2370	99.50 - 100.00	38.50 - 39.00	3.725	.138	181.63	3.944	.235	276.02
2371	99.50 - 100.00	39.00 - 39.50	3.730	.132	171.07	3.944	.235	270.91
2372	99.50 - 100.00	39.50 - 40.00	3.613	.124	78.87	3.959	.225	267.69
2373	99.50 - 100.00	40.00 - 40.50	3.558	.082	146.40	3.959	.225	266.46
2374	99.50 - 100.00	40.50 - 41.00	3.528	.075	162.14	3.955	.231	265.72
2375	99.50 - 100.00	41.00 - 41.50	3.528	.075	163.41	3.952	.236	264.82
2376	99.50 - 100.00	41.50 - 42.00	3.504	.063	156.36	3.939	.234	260.22
2377	99.50 - 100.00	42.00 - 42.50	3.522	.083	152.50	3.935	.240	254.60
2378	99.50 - 100.00	42.50 - 43.00	3.522	.083	144.20	3.935	.240	246.84
2379	99.50 - 100.00	43.00 - 43.50	3.549	.099	139.78	3.987	.236	234.10
2380	99.50 - 100.00	43.50 - 44.00	3.450	.146	123.69	3.981	.241	202.34

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2381	99.50 - 100.00	44.00 - 44.50	3.328	.240	109.40	3.302	.286	128.73
2382	99.50 - 100.00	44.50 - 45.00	3.292	.219	117.04	3.071	.238	132.48
2383	99.50 - 100.00	45.00 - 45.50	3.292	.219	135.11	3.071	.238	164.14
2384	99.50 - 100.00	45.50 - 46.00	3.375	.169	181.23	3.071	.238	193.92
2385	99.50 - 100.00	46.00 - 46.50	3.324	.398	167.59	3.071	.238	223.29
2386	99.50 - 100.00	46.50 - 47.00	3.324	.398	177.56	3.071	.238	252.80
2387	99.50 - 100.00	47.00 - 47.50	3.266	.397	185.46	2.835	.163	270.20
2388	99.50 - 100.00	47.50 - 48.00	3.228	.403	187.87	2.835	.163	299.99
2389	99.50 - 100.00	48.00 - 48.50	3.201	.424	187.54	2.446	.074	334.16
2390	99.50 - 100.00	48.50 - 49.00	3.082	.490	175.10	.000	.000	.00
2391	99.50 - 100.00	49.00 - 49.50	3.082	.490	172.85	.000	.000	.00
2392	99.50 - 100.00	49.50 - 50.00	3.082	.490	173.18	.000	.000	.00
2393	100.00 - 100.50	25.00 - 25.50	.000	.000	.00	2.597	.225	253.19
2394	100.00 - 100.50	25.50 - 26.00	.000	.000	.00	2.597	.225	229.76
2395	100.00 - 100.50	26.00 - 26.50	2.181	.000	218.50	2.597	.225	210.52
2396	100.00 - 100.50	26.50 - 27.00	2.877	.462	196.82	2.597	.225	196.98
2397	100.00 - 100.50	27.00 - 27.50	2.877	.462	183.40	2.597	.225	190.38
2398	100.00 - 100.50	27.50 - 28.00	3.028	.337	200.98	2.597	.225	190.93
2399	100.00 - 100.50	28.00 - 28.50	3.028	.337	187.68	2.597	.225	197.62
2400	100.00 - 100.50	28.50 - 29.00	3.028	.337	176.03	2.597	.225	208.89
2401	100.00 - 100.50	29.00 - 29.50	3.028	.337	166.38	2.597	.225	223.52
2402	100.00 - 100.50	29.50 - 30.00	3.052	.315	161.75	2.597	.225	240.84
2403	100.00 - 100.50	30.00 - 30.50	3.052	.315	156.83	2.597	.225	260.54
2404	100.00 - 100.50	30.50 - 31.00	3.127	.274	164.43	2.597	.225	282.42
2405	100.00 - 100.50	31.00 - 31.50	3.403	.188	203.51	2.597	.225	306.24
2406	100.00 - 100.50	31.50 - 32.00	3.522	.152	203.15	2.446	.074	280.74
2407	100.00 - 100.50	32.00 - 32.50	3.546	.145	191.62	2.534	.014	261.26
2408	100.00 - 100.50	32.50 - 33.00	3.546	.145	179.77	2.597	.076	241.39
2409	100.00 - 100.50	33.00 - 33.50	3.560	.150	165.61	2.722	.187	237.43
2410	100.00 - 100.50	33.50 - 34.00	3.566	.144	148.35	2.754	.184	203.24
2411	100.00 - 100.50	34.00 - 34.50	3.566	.144	129.30	2.754	.184	176.29
2412	100.00 - 100.50	34.50 - 35.00	3.559	.152	110.97	2.754	.184	148.73
2413	100.00 - 100.50	35.00 - 35.50	3.578	.154	104.52	2.881	.065	141.95
2414	100.00 - 100.50	35.50 - 36.00	3.636	.144	114.67	3.833	.237	281.90
2415	100.00 - 100.50	36.00 - 36.50	3.636	.144	126.38	3.899	.227	288.46

SEISMIC MAP OF CONTINENTAL U.S.

GFID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2416	100.00 - 100.50	36.50 - 37.00	3.707	.147	140.21	3.946	.235	280.85
2417	100.00 - 100.50	37.00 - 37.50	3.751	.138	145.77	3.946	.235	269.26
2418	100.00 - 100.50	37.50 - 38.00	3.751	.138	89.45	3.946	.235	257.72
2419	100.00 - 100.50	38.00 - 38.50	3.746	.143	161.24	3.946	.235	248.24
2420	100.00 - 100.50	38.50 - 39.00	3.764	.143	183.71	3.989	.237	249.54
2421	100.00 - 100.50	39.00 - 39.50	3.752	.131	181.50	3.989	.237	244.25
2422	100.00 - 100.50	39.50 - 40.00	3.639	.136	144.88	4.001	.229	241.50
2423	100.00 - 100.50	40.00 - 40.50	3.589	.095	158.68	4.008	.225	242.09
2424	100.00 - 100.50	40.50 - 41.00	3.563	.086	168.46	4.005	.230	242.77
2425	100.00 - 100.50	41.00 - 41.50	3.556	.093	169.94	4.002	.234	242.86
2426	100.00 - 100.50	41.50 - 42.00	3.534	.079	162.29	3.990	.232	238.26
2427	100.00 - 100.50	42.00 - 42.50	3.528	.086	152.82	3.987	.236	231.27
2428	100.00 - 100.50	42.50 - 43.00	3.528	.086	139.70	3.987	.236	226.09
2429	100.00 - 100.50	43.00 - 43.50	3.557	.091	132.22	3.999	.239	228.68
2430	100.00 - 100.50	43.50 - 44.00	3.459	.140	122.86	3.993	.243	236.94
2431	100.00 - 100.50	44.00 - 44.50	3.338	.239	115.64	3.377	.268	150.22
2432	100.00 - 100.50	44.50 - 45.00	3.304	.218	124.76	3.190	.210	147.49
2433	100.00 - 100.50	45.00 - 45.50	3.304	.218	140.35	3.190	.210	176.39
2434	100.00 - 100.50	45.50 - 46.00	3.395	.149	185.71	3.190	.210	205.61
2435	100.00 - 100.50	46.00 - 46.50	3.324	.398	167.82	3.190	.210	235.09
2436	100.00 - 100.50	46.50 - 47.00	3.324	.398	175.62	3.190	.210	264.88
2437	100.00 - 100.50	47.00 - 47.50	3.266	.397	180.48	2.954	.145	266.01
2438	100.00 - 100.50	47.50 - 48.00	3.228	.403	180.04	2.954	.145	293.31
2439	100.00 - 100.50	48.00 - 48.50	3.201	.424	177.39	2.446	.074	320.38
2440	100.00 - 100.50	48.50 - 49.00	3.082	.490	161.88	.000	.000	.00
2441	100.00 - 100.50	49.00 - 49.50	3.082	.490	159.04	.000	.000	.00
2442	100.00 - 100.50	49.50 - 50.00	3.082	.490	159.07	.000	.000	.00
2443	100.50 - 101.00	25.00 - 25.50	.000	.000	.00	2.597	.225	230.03
2444	100.50 - 101.00	25.50 - 26.00	.000	.000	.00	2.597	.225	203.43
2445	100.50 - 101.00	26.00 - 26.50	2.181	.000	207.07	2.946	.177	246.61
2446	100.50 - 101.00	26.50 - 27.00	2.877	.462	186.45	2.946	.177	226.41
2447	100.50 - 101.00	27.00 - 27.50	2.877	.462	172.23	2.946	.177	215.22
2448	100.50 - 101.00	27.50 - 28.00	3.028	.337	188.78	2.946	.177	213.33
2449	100.50 - 101.00	28.00 - 28.50	3.028	.337	174.54	2.946	.177	217.87
2450	100.50 - 101.00	28.50 - 29.00	3.028	.337	161.97	2.946	.177	225.33

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2451	100.50 - 101.00	29.00 - 29.50	3.028	.337	151.48	2.946	.177	233.94
2452	100.50 - 101.00	29.50 - 30.00	3.028	.337	143.53	2.946	.177	243.49
2453	100.50 - 101.00	30.00 - 30.50	3.028	.337	138.56	2.946	.177	254.39
2454	100.50 - 101.00	30.50 - 31.00	3.176	.273	150.80	2.946	.177	267.14
2455	100.50 - 101.00	31.00 - 31.50	3.427	.191	187.24	2.946	.177	282.10
2456	100.50 - 101.00	31.50 - 32.00	3.535	.166	190.05	2.884	.114	280.27
2457	100.50 - 101.00	32.00 - 32.50	3.558	.159	181.48	2.923	.074	280.02
2458	100.50 - 101.00	32.50 - 33.00	3.565	.150	170.71	2.957	.041	275.72
2459	100.50 - 101.00	33.00 - 33.50	3.579	.157	159.51	2.962	.034	249.83
2460	100.50 - 101.00	33.50 - 34.00	3.584	.151	143.97	2.981	.012	224.61
2461	100.50 - 101.00	34.00 - 34.50	3.584	.151	123.92	2.981	.012	199.98
2462	100.50 - 101.00	34.50 - 35.00	3.577	.158	96.44	2.754	.184	130.79
2463	100.50 - 101.00	35.00 - 35.50	3.595	.169	75.15	2.881	.065	109.96
2464	100.50 - 101.00	35.50 - 36.00	3.652	.156	89.51	3.882	.252	226.87
2465	100.50 - 101.00	36.00 - 36.50	3.672	.163	117.01	3.946	.235	256.79
2466	100.50 - 101.00	36.50 - 37.00	3.683	.150	137.77	3.955	.227	255.90
2467	100.50 - 101.00	37.00 - 37.50	3.728	.145	151.93	3.955	.227	244.98
2468	100.50 - 101.00	37.50 - 38.00	3.734	.137	146.93	3.955	.227	233.07
2469	100.50 - 101.00	38.00 - 38.50	3.729	.143	169.13	3.955	.227	223.89
2470	100.50 - 101.00	38.50 - 39.00	3.765	.141	189.58	3.998	.229	225.53
2471	100.50 - 101.00	39.00 - 39.50	3.753	.130	194.70	3.998	.229	220.30
2472	100.50 - 101.00	39.50 - 40.00	3.640	.135	172.75	4.021	.224	220.09
2473	100.50 - 101.00	40.00 - 40.50	3.590	.095	171.17	4.021	.224	220.09
2474	100.50 - 101.00	40.50 - 41.00	3.564	.085	173.16	4.016	.232	221.67
2475	100.50 - 101.00	41.00 - 41.50	3.557	.091	172.15	4.013	.237	222.38
2476	100.50 - 101.00	41.50 - 42.00	3.536	.077	162.55	4.002	.234	216.35
2477	100.50 - 101.00	42.00 - 42.50	3.529	.084	149.20	3.999	.239	201.75
2478	100.50 - 101.00	42.50 - 43.00	3.529	.084	125.39	3.999	.239	190.09
2479	100.50 - 101.00	43.00 - 43.50	3.536	.077	99.19	4.022	.234	208.55
2480	100.50 - 101.00	43.50 - 44.00	3.436	.122	107.00	3.999	.239	229.72
2481	100.50 - 101.00	44.00 - 44.50	3.312	.218	111.12	3.377	.268	147.12
2482	100.50 - 101.00	44.50 - 45.00	3.274	.194	124.40	3.190	.210	141.92
2483	100.50 - 101.00	45.00 - 45.50	3.274	.194	141.05	3.190	.210	169.02
2484	100.50 - 101.00	45.50 - 46.00	3.347	.133	181.34	3.190	.210	197.61
2485	100.50 - 101.00	46.00 - 46.50	3.304	.393	168.03	3.190	.210	227.01

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
2486	100.50 - 101.00	46.50 - 47.00	3.304	.393	173.96	3.196	.210	256.98
2487	100.50 - 101.00	47.00 - 47.50	3.239	.396	174.51	2.954	.145	257.92
2488	100.50 - 101.00	47.50 - 48.00	3.194	.408	169.28	2.954	.145	285.48
2489	100.50 - 101.00	48.00 - 48.50	3.162	.435	162.71	2.446	.074	307.71
2490	100.50 - 101.00	48.50 - 49.00	3.082	.490	148.04	2.746	.503	286.96
2491	100.50 - 101.00	49.00 - 49.50	3.082	.490	144.75	2.746	.503	297.15
2492	100.50 - 101.00	49.50 - 50.00	3.082	.490	144.61	2.746	.503	310.85
2493	101.00 - 101.50	27.00 - 27.50	2.877	.462	161.88	3.225	.226	194.42
2494	101.00 - 101.50	27.50 - 28.00	2.877	.462	147.66	3.199	.209	188.86
2495	101.00 - 101.50	28.00 - 28.50	2.877	.462	134.52	3.199	.209	190.90
2496	101.00 - 101.50	28.50 - 29.00	2.877	.462	122.79	3.199	.209	193.41
2497	101.00 - 101.50	29.00 - 29.50	2.877	.462	112.89	3.199	.209	195.71
2498	101.00 - 101.50	29.50 - 30.00	2.877	.462	105.33	3.199	.209	198.70
2499	101.00 - 101.50	30.00 - 30.50	2.877	.462	100.66	3.199	.209	203.28
2500	101.00 - 101.50	30.50 - 31.00	3.123	.288	127.93	3.199	.209	210.02
2501	101.00 - 101.50	31.00 - 31.50	3.399	.203	169.37	3.199	.209	219.21
2502	101.00 - 101.50	31.50 - 32.00	3.519	.163	179.59	3.210	.207	228.65
2503	101.00 - 101.50	32.00 - 32.50	3.543	.154	174.22	3.231	.206	232.00
2504	101.00 - 101.50	32.50 - 33.00	3.551	.144	165.96	3.240	.207	234.32
2505	101.00 - 101.50	33.00 - 33.50	3.565	.150	156.49	3.341	.095	264.29
2506	101.00 - 101.50	33.50 - 34.00	3.571	.144	141.80	3.223	.189	220.26
2507	101.00 - 101.50	34.00 - 34.50	3.571	.144	120.20	3.223	.189	205.77
2508	101.00 - 101.50	34.50 - 35.00	3.564	.152	84.08	2.922	.071	137.60
2509	101.00 - 101.50	35.00 - 35.50	3.578	.161	31.73	2.981	.012	100.24
2510	101.00 - 101.50	35.50 - 36.00	3.636	.151	48.49	3.892	.246	119.92
2511	101.00 - 101.50	36.00 - 36.50	3.656	.157	105.84	3.955	.227	228.77
2512	101.00 - 101.50	36.50 - 37.00	3.759	.152	137.46	3.991	.221	235.70
2513	101.00 - 101.50	37.00 - 37.50	3.798	.148	157.15	3.991	.221	222.70
2514	101.00 - 101.50	37.50 - 38.00	3.803	.141	165.52	3.991	.221	209.01
2515	101.00 - 101.50	38.00 - 38.50	3.803	.141	177.05	3.991	.221	201.32
2516	101.00 - 101.50	38.50 - 39.00	3.833	.140	190.94	4.032	.218	203.37
2517	101.00 - 101.50	39.00 - 39.50	3.823	.130	198.69	4.032	.218	198.09
2518	101.00 - 101.50	39.50 - 40.00	3.691	.109	185.15	4.053	.216	198.23
2519	101.00 - 101.50	40.00 - 40.50	3.638	.084	182.11	4.053	.216	199.41
2520	101.00 - 101.50	40.50 - 41.00	3.612	.083	181.05	4.038	.229	201.42

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2521	101.00 - 101.50	41.00 - 41.50	3.605	.093	178.89	4.035	.233	204.30
2522	101.00 - 101.50	41.50 - 42.00	3.577	.098	168.81	4.025	.230	198.45
2523	101.00 - 101.50	42.00 - 42.50	3.571	.107	153.08	4.022	.234	171.43
2524	101.00 - 101.50	42.50 - 43.00	3.571	.107	120.20	4.022	.234	133.93
2525	101.00 - 101.50	43.00 - 43.50	3.537	.075	48.46	4.055	.230	178.04
2526	101.00 - 101.50	43.50 - 44.00	3.428	.128	86.84	4.059	.235	216.89
2527	101.00 - 101.50	44.00 - 44.50	3.304	.218	103.42	3.579	.258	166.00
2528	101.00 - 101.50	44.50 - 45.00	3.274	.194	123.80	3.447	.242	173.60
2529	101.00 - 101.50	45.00 - 45.50	3.274	.194	142.16	3.421	.261	197.54
2530	101.00 - 101.50	45.50 - 46.00	3.347	.133	182.02	3.421	.261	224.20
2531	101.00 - 101.50	46.00 - 46.50	3.304	.393	166.49	3.421	.261	248.82
2532	101.00 - 101.50	46.50 - 47.00	3.304	.393	170.18	3.421	.261	271.53
2533	101.00 - 101.50	47.00 - 47.50	3.239	.396	167.06	3.271	.212	274.73
2534	101.00 - 101.50	47.50 - 48.00	3.194	.408	158.55	3.271	.212	291.91
2535	101.00 - 101.50	48.00 - 48.50	3.162	.435	149.58	2.940	.316	276.12
2536	101.00 - 101.50	48.50 - 49.00	3.046	.489	125.93	2.746	.503	264.52
2537	101.00 - 101.50	49.00 - 49.50	2.993	.552	117.03	2.746	.503	275.54
2538	101.00 - 101.50	49.50 - 50.00	2.993	.552	116.60	2.746	.503	290.26
2539	101.50 - 102.00	27.00 - 27.50	2.877	.462	152.50	3.225	.226	155.94
2540	101.50 - 102.00	27.50 - 28.00	2.877	.462	137.33	3.225	.226	159.54
2541	101.50 - 102.00	28.00 - 28.50	2.677	.462	123.12	3.225	.226	168.15
2542	101.50 - 102.00	28.50 - 29.00	2.877	.462	110.20	3.225	.226	172.79
2543	101.50 - 102.00	29.00 - 29.50	2.877	.462	99.08	3.225	.226	175.02
2544	101.50 - 102.00	29.50 - 30.00	2.877	.462	90.39	3.225	.226	177.35
2545	101.50 - 102.00	30.00 - 30.50	2.877	.462	84.86	3.225	.226	181.19
2546	101.50 - 102.00	30.50 - 31.00	3.123	.288	109.54	3.225	.226	187.26
2547	101.50 - 102.00	31.00 - 31.50	3.474	.161	151.95	3.225	.226	195.93
2548	101.50 - 102.00	31.50 - 32.00	3.572	.153	159.91	3.236	.225	206.10
2549	101.50 - 102.00	32.00 - 32.50	3.591	.154	157.20	3.299	.258	213.66
2550	101.50 - 102.00	32.50 - 33.00	3.597	.148	151.54	3.307	.259	216.63
2551	101.50 - 102.00	33.00 - 33.50	3.614	.152	144.06	3.407	.140	245.85
2552	101.50 - 102.00	33.50 - 34.00	3.618	.149	132.93	3.294	.245	206.92
2553	101.50 - 102.00	34.00 - 34.50	3.618	.149	117.13	3.294	.245	195.36
2554	101.50 - 102.00	34.50 - 35.00	3.647	.143	97.60	3.101	.102	153.85
2555	101.50 - 102.00	35.00 - 35.50	3.616	.181	72.81	3.294	.099	151.48

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2556	101.50 - 102.00	35.50 - 36.00	3.622	.176	78.61	3.936	.244	208.50
2557	101.50 - 102.00	36.00 - 36.50	3.640	.188	97.77	3.991	.221	225.01
2558	101.50 - 102.00	36.50 - 37.00	3.798	.170	123.37	4.046	.227	220.19
2559	101.50 - 102.00	37.00 - 37.50	3.820	.179	139.27	4.046	.227	202.65
2560	101.50 - 102.00	37.50 - 38.00	3.823	.178	148.64	4.046	.227	180.97
2561	101.50 - 102.00	38.00 - 38.50	3.823	.178	158.16	4.046	.227	182.05
2562	101.50 - 102.00	38.50 - 39.00	3.835	.188	168.69	4.084	.215	185.55
2563	101.50 - 102.00	39.00 - 39.50	3.778	.155	176.50	4.084	.215	179.63
2564	101.50 - 102.00	39.50 - 40.00	3.682	.100	175.59	4.093	.211	177.63
2565	101.50 - 102.00	40.00 - 40.50	3.621	.073	178.04	4.093	.211	179.68
2566	101.50 - 102.00	40.50 - 41.00	3.594	.074	176.09	4.079	.221	183.88
2567	101.50 - 102.00	41.00 - 41.50	3.586	.085	173.26	4.072	.227	189.28
2568	101.50 - 102.00	41.50 - 42.00	3.556	.093	162.18	4.058	.226	185.93
2569	101.50 - 102.00	42.00 - 42.50	3.549	.102	146.36	4.055	.230	153.76
2570	101.50 - 102.00	42.50 - 43.00	3.549	.102	121.98	4.055	.230	63.10
2571	101.50 - 102.00	43.00 - 43.50	3.546	.066	91.25	4.065	.220	154.78
2572	101.50 - 102.00	43.50 - 44.00	3.447	.115	57.09	4.062	.231	179.06
2573	101.50 - 102.00	44.00 - 44.50	3.324	.219	97.41	3.587	.246	146.15
2574	101.50 - 102.00	44.50 - 45.00	3.297	.195	120.23	3.447	.242	161.29
2575	101.50 - 102.00	45.00 - 45.50	3.286	.194	138.66	3.421	.261	187.45
2576	101.50 - 102.00	45.50 - 46.00	3.366	.114	177.61	3.421	.261	214.53
2577	101.50 - 102.00	46.00 - 46.50	3.313	.391	159.26	3.421	.261	238.73
2578	101.50 - 102.00	46.50 - 47.00	3.313	.391	161.10	3.421	.261	260.53
2579	101.50 - 102.00	47.00 - 47.50	3.251	.390	155.10	3.271	.212	260.92
2580	101.50 - 102.00	47.50 - 48.00	3.209	.398	144.74	3.271	.212	277.05
2581	101.50 - 102.00	48.00 - 48.50	3.183	.416	135.35	2.940	.316	255.67
2582	101.50 - 102.00	48.50 - 49.00	3.046	.489	111.68	2.746	.503	242.22
2583	101.50 - 102.00	49.00 - 49.50	2.993	.552	102.99	2.746	.503	254.21
2584	101.50 - 102.00	49.50 - 50.00	2.993	.552	102.70	2.746	.503	270.10
2585	102.00 - 102.50	28.00 - 28.50	2.877	.462	112.83	3.225	.226	145.36
2586	102.00 - 102.50	28.50 - 29.00	2.877	.462	98.62	3.225	.226	151.90
2587	102.00 - 102.50	29.00 - 29.50	2.877	.462	86.06	3.225	.226	153.86
2588	102.00 - 102.50	29.50 - 30.00	2.877	.462	75.91	3.225	.226	155.87
2589	102.00 - 102.50	30.00 - 30.50	2.943	.430	73.09	3.250	.243	162.39
2590	102.00 - 102.50	30.50 - 31.00	3.400	.159	115.82	3.250	.243	168.17

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
2591	102.00 - 102.50	31.00 - 31.50	3.591	.120	135.54	3.453	.147	222.21
2592	102.00 - 102.50	31.50 - 32.00	3.764	.148	160.29	3.461	.136	231.79
2593	102.00 - 102.50	32.00 - 32.50	3.779	.143	159.19	3.513	.132	239.94
2594	102.00 - 102.50	32.50 - 33.00	3.783	.138	154.46	3.535	.134	243.19
2595	102.00 - 102.50	33.00 - 33.50	3.796	.135	148.32	3.592	.123	254.23
2596	102.00 - 102.50	33.50 - 34.00	3.799	.131	139.62	3.541	.130	232.92
2597	102.00 - 102.50	34.00 - 34.50	3.799	.131	128.78	3.541	.130	221.77
2598	102.00 - 102.50	34.50 - 35.00	3.818	.129	118.97	3.415	.103	191.65
2599	102.00 - 102.50	35.00 - 35.50	3.720	.149	95.39	3.562	.150	194.98
2600	102.00 - 102.50	35.50 - 36.00	3.723	.147	91.05	3.983	.260	218.53
2601	102.00 - 102.50	36.00 - 36.50	3.733	.156	90.20	4.041	.228	215.02
2602	102.00 - 102.50	36.50 - 37.00	4.033	.153	135.54	4.126	.217	198.02
2603	102.00 - 102.50	37.00 - 37.50	4.051	.145	154.17	4.126	.217	181.33
2604	102.00 - 102.50	37.50 - 38.00	4.053	.141	165.45	4.126	.217	125.20
2605	102.00 - 102.50	38.00 - 38.50	4.053	.141	175.83	4.126	.217	164.01
2606	102.00 - 102.50	38.50 - 39.00	3.802	.181	152.57	4.147	.222	164.10
2607	102.00 - 102.50	39.00 - 39.50	3.739	.147	157.86	4.147	.222	157.67
2608	102.00 - 102.50	39.50 - 40.00	3.621	.129	150.91	4.152	.221	155.39
2609	102.00 - 102.50	40.00 - 40.50	3.515	.160	142.35	4.152	.221	159.10
2610	102.00 - 102.50	40.50 - 41.00	3.495	.143	139.97	4.144	.224	167.67
2611	102.00 - 102.50	41.00 - 41.50	3.488	.143	138.21	4.071	.215	167.08
2612	102.00 - 102.50	41.50 - 42.00	3.458	.124	129.11	4.068	.217	176.62
2613	102.00 - 102.50	42.00 - 42.50	3.443	.127	116.01	4.065	.220	162.10
2614	102.00 - 102.50	42.50 - 43.00	3.411	.100	99.49	4.065	.220	132.51
2615	102.00 - 102.50	43.00 - 43.50	3.517	.057	107.12	4.112	.221	167.86
2616	102.00 - 102.50	43.50 - 44.00	3.413	.099	89.80	4.077	.229	107.98
2617	102.00 - 102.50	44.00 - 44.50	3.288	.194	95.83	3.639	.230	136.39
2618	102.00 - 102.50	44.50 - 45.00	3.288	.194	118.06	3.516	.224	159.52
2619	102.00 - 102.50	45.00 - 45.50	3.277	.194	137.13	3.495	.239	188.96
2620	102.00 - 102.50	45.50 - 46.00	3.351	.129	174.22	3.495	.239	216.53
2621	102.00 - 102.50	46.00 - 46.50	3.306	.393	156.62	3.472	.257	236.24
2622	102.00 - 102.50	46.50 - 47.00	3.306	.393	156.38	3.472	.257	256.95
2623	102.00 - 102.50	47.00 - 47.50	3.242	.395	146.43	3.333	.221	255.10
2624	102.00 - 102.50	47.50 - 48.00	3.209	.398	133.35	3.333	.221	270.50
2625	102.00 - 102.50	48.00 - 48.50	3.183	.416	121.22	2.940	.316	235.06

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
2626	102.00 - 102.50	48.50 - 49.00	3.046	.489	97.26	2.746	.503	220.10
2627	102.00 - 102.50	49.00 - 49.50	2.993	.552	89.11	2.746	.503	233.23
2628	102.00 - 102.50	49.50 - 50.00	2.993	.552	89.06	2.746	.503	250.46
2629	102.50 - 103.00	28.00 - 28.50	2.877	.462	103.96	3.225	.226	128.22
2630	102.50 - 103.00	28.50 - 29.00	2.877	.462	88.40	3.225	.226	132.17
2631	102.50 - 103.00	29.00 - 29.50	2.877	.462	74.22	3.225	.226	132.86
2632	102.50 - 103.00	29.50 - 30.00	2.877	.462	62.25	3.225	.226	134.54
2633	102.50 - 103.00	30.00 - 30.50	3.712	.299	132.10	3.250	.243	140.83
2634	102.50 - 103.00	30.50 - 31.00	3.830	.243	135.93	3.250	.243	146.87
2635	102.50 - 103.00	31.00 - 31.50	3.899	.211	141.49	3.453	.147	197.84
2636	102.50 - 103.00	31.50 - 32.00	3.973	.222	152.49	3.461	.136	209.50
2637	102.50 - 103.00	32.00 - 32.50	3.983	.215	151.75	3.513	.132	220.97
2638	102.50 - 103.00	32.50 - 33.00	3.987	.211	147.73	3.712	.210	239.01
2639	102.50 - 103.00	33.00 - 33.50	3.997	.205	142.82	3.843	.130	257.95
2640	102.50 - 103.00	33.50 - 34.00	4.002	.198	136.49	3.830	.121	245.12
2641	102.50 - 103.00	34.00 - 34.50	4.010	.197	130.38	3.830	.121	231.96
2642	102.50 - 103.00	34.50 - 35.00	4.023	.194	125.90	3.792	.127	218.89
2643	102.50 - 103.00	35.00 - 35.50	3.983	.169	112.99	3.840	.140	202.87
2644	102.50 - 103.00	35.50 - 36.00	3.986	.166	101.97	4.094	.218	202.73
2645	102.50 - 103.00	36.00 - 36.50	3.993	.166	73.24	4.124	.218	183.84
2646	102.50 - 103.00	36.50 - 37.00	4.041	.154	123.77	4.161	.226	183.11
2647	102.50 - 103.00	37.00 - 37.50	4.041	.154	140.70	4.161	.226	172.51
2648	102.50 - 103.00	37.50 - 38.00	4.044	.151	151.60	4.164	.226	158.29
2649	102.50 - 103.00	38.00 - 38.50	4.044	.151	161.12	4.164	.226	153.75
2650	102.50 - 103.00	38.50 - 39.00	3.779	.194	136.55	4.181	.232	146.80
2651	102.50 - 103.00	39.00 - 39.50	3.713	.167	139.76	4.181	.232	136.99
2652	102.50 - 103.00	39.50 - 40.00	3.582	.214	128.89	4.191	.235	134.12
2653	102.50 - 103.00	40.00 - 40.50	3.422	.331	111.75	4.191	.235	138.97
2654	102.50 - 103.00	40.50 - 41.00	3.404	.316	111.40	4.184	.237	150.97
2655	102.50 - 103.00	41.00 - 41.50	3.397	.315	111.69	4.119	.226	157.02
2656	102.50 - 103.00	41.50 - 42.00	3.370	.297	105.56	4.136	.213	178.58
2657	102.50 - 103.00	42.00 - 42.50	3.354	.295	90.97	4.130	.219	182.13
2658	102.50 - 103.00	42.50 - 43.00	3.259	.217	65.64	4.117	.219	179.37
2659	102.50 - 103.00	43.00 - 43.50	3.316	.200	78.36	4.112	.221	185.51
2660	102.50 - 103.00	43.50 - 44.00	3.307	.197	76.42	4.077	.229	173.33

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2661	102.50 - 103.00	44.00 - 44.50	3.299	.195	92.35	3.639	.230	125.40
2662	102.50 - 103.00	44.50 - 45.00	3.299	.195	113.26	3.516	.224	147.37
2663	102.50 - 103.00	45.00 - 45.50	3.288	.194	132.80	3.495	.239	180.14
2664	102.50 - 103.00	45.50 - 46.00	3.370	.110	170.16	3.495	.239	207.78
2665	102.50 - 103.00	46.00 - 46.50	3.314	.391	150.37	3.472	.257	226.71
2666	102.50 - 103.00	46.50 - 47.00	3.314	.391	148.77	3.472	.257	245.82
2667	102.50 - 103.00	47.00 - 47.50	3.253	.389	136.52	3.333	.221	240.44
2668	102.50 - 103.00	47.50 - 48.00	3.222	.391	121.13	3.333	.221	254.28
2669	102.50 - 103.00	48.00 - 48.50	3.183	.416	106.23	2.940	.316	214.13
2670	102.50 - 103.00	48.50 - 49.00	3.046	.489	82.47	2.746	.503	198.24
2671	102.50 - 103.00	49.00 - 49.50	2.993	.552	75.44	2.746	.503	212.72
2672	102.50 - 103.00	49.50 - 50.00	2.993	.552	75.80	2.746	.503	231.48
2673	103.00 - 103.50	28.00 - 28.50	2.877	.462	96.89	3.368	.135	135.25
2674	103.00 - 103.50	28.50 - 29.00	2.877	.462	80.01	3.368	.135	130.11
2675	103.00 - 103.50	29.00 - 29.50	2.877	.462	64.14	3.368	.135	130.38
2676	103.00 - 103.50	29.50 - 30.00	2.877	.462	50.02	3.368	.135	132.86
2677	103.00 - 103.50	30.00 - 30.50	3.712	.299	105.60	3.385	.141	138.14
2678	103.00 - 103.50	30.50 - 31.00	3.830	.243	106.43	3.385	.141	145.29
2679	103.00 - 103.50	31.00 - 31.50	3.899	.211	118.60	3.490	.140	174.26
2680	103.00 - 103.50	31.50 - 32.00	3.962	.228	135.15	3.497	.132	188.08
2681	103.00 - 103.50	32.00 - 32.50	3.973	.221	138.23	3.533	.128	199.25
2682	103.00 - 103.50	32.50 - 33.00	3.977	.216	135.17	3.808	.138	249.56
2683	103.00 - 103.50	33.00 - 33.50	3.987	.210	130.34	3.893	.120	254.85
2684	103.00 - 103.50	33.50 - 34.00	3.993	.203	124.30	3.835	.122	229.73
2685	103.00 - 103.50	34.00 - 34.50	4.018	.199	119.89	3.855	.130	218.24
2686	103.00 - 103.50	34.50 - 35.00	4.030	.195	116.23	3.826	.132	204.79
2687	103.00 - 103.50	35.00 - 35.50	3.990	.172	103.32	3.916	.135	198.71
2688	103.00 - 103.50	35.50 - 36.00	3.993	.169	69.68	4.134	.223	190.63
2689	103.00 - 103.50	36.00 - 36.50	4.000	.169	98.75	4.159	.226	130.18
2690	103.00 - 103.50	36.50 - 37.00	4.013	.161	115.30	4.166	.226	163.73
2691	103.00 - 103.50	37.00 - 37.50	4.011	.164	128.22	4.166	.226	156.90
2692	103.00 - 103.50	37.50 - 38.00	4.013	.161	138.19	4.169	.226	149.60
2693	103.00 - 103.50	38.00 - 38.50	4.013	.161	147.18	4.169	.226	139.26
2694	103.00 - 103.50	38.50 - 39.00	3.725	.184	121.28	4.186	.231	126.73
2695	103.00 - 103.50	39.00 - 39.50	3.644	.163	120.88	4.186	.231	112.02

SEISMIC MAP OF CONTINENTAL U.S.

GFID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2696	103.00 - 103.50	39.50 - 40.00	3.554	.183	114.85	4.195	.234	106.71
2697	103.00 - 103.50	40.00 - 40.50	3.411	.318	99.81	4.195	.234	113.10
2698	103.00 - 103.50	40.50 - 41.00	3.393	.303	100.20	4.189	.237	129.89
2699	103.00 - 103.50	41.00 - 41.50	3.385	.301	101.87	4.125	.225	142.24
2700	103.00 - 103.50	41.50 - 42.00	3.357	.281	97.35	4.144	.209	169.95
2701	103.00 - 103.50	42.00 - 42.50	3.341	.278	81.03	4.130	.219	182.60
2702	103.00 - 103.50	42.50 - 43.00	3.238	.191	31.50	4.117	.219	190.29
2703	103.00 - 103.50	43.00 - 43.50	3.390	.089	83.27	4.138	.221	200.48
2704	103.00 - 103.50	43.50 - 44.00	3.373	.106	52.43	4.105	.228	196.13
2705	103.00 - 103.50	44.00 - 44.50	3.359	.121	87.67	3.724	.211	88.72
2706	103.00 - 103.50	44.50 - 45.00	3.359	.121	120.29	3.554	.225	143.51
2707	103.00 - 103.50	45.00 - 45.50	3.339	.141	146.59	3.535	.239	178.95
2708	103.00 - 103.50	45.50 - 46.00	3.339	.141	163.75	3.535	.239	205.70
2709	103.00 - 103.50	46.00 - 46.50	3.301	.395	147.34	3.515	.256	224.15
2710	103.00 - 103.50	46.50 - 47.00	3.301	.395	143.78	3.515	.256	241.39
2711	103.00 - 103.50	47.00 - 47.50	3.253	.389	128.91	3.385	.231	233.40
2712	103.00 - 103.50	47.50 - 48.00	3.222	.391	109.65	3.333	.221	236.88
2713	103.00 - 103.50	48.00 - 48.50	3.183	.416	90.24	2.940	.316	192.67
2714	103.00 - 103.50	48.50 - 49.00	3.046	.489	66.88	2.746	.503	176.71
2715	103.00 - 103.50	49.00 - 49.50	2.993	.552	62.10	2.746	.503	192.82
2716	103.00 - 103.50	49.50 - 50.00	2.993	.552	63.11	2.746	.503	213.33
2717	103.50 - 104.00	28.00 - 28.50	2.877	.462	92.01	3.368	.135	116.43
2718	103.50 - 104.00	28.50 - 29.00	2.915	.440	76.44	3.368	.135	95.19
2719	103.50 - 104.00	29.00 - 29.50	2.915	.440	58.81	3.368	.135	104.46
2720	103.50 - 104.00	29.50 - 30.00	2.915	.440	42.18	3.368	.135	109.37
2721	103.50 - 104.00	30.00 - 30.50	3.719	.291	77.92	3.385	.141	113.27
2722	103.50 - 104.00	30.50 - 31.00	3.824	.241	65.49	3.385	.141	120.86
2723	103.50 - 104.00	31.00 - 31.50	3.894	.208	91.80	3.490	.140	150.60
2724	103.50 - 104.00	31.50 - 32.00	3.958	.226	119.85	3.497	.132	167.54
2725	103.50 - 104.00	32.00 - 32.50	3.969	.218	126.19	3.533	.128	182.49
2726	103.50 - 104.00	32.50 - 33.00	3.973	.214	123.28	3.808	.138	233.54
2727	103.50 - 104.00	33.00 - 33.50	3.976	.210	116.94	3.893	.120	239.74
2728	103.50 - 104.00	33.50 - 34.00	3.982	.202	110.39	3.845	.126	215.17
2729	103.50 - 104.00	34.00 - 34.50	4.008	.197	105.99	3.864	.133	202.95
2730	103.50 - 104.00	34.50 - 35.00	4.021	.194	103.19	3.836	.132	188.36

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2731	103.50 - 104.00	35.00 - 35.50	3.981	.169	94.99	3.924	.135	182.58
2732	103.50 - 104.00	35.50 - 36.00	3.983	.166	90.82	4.139	.222	180.90
2733	103.50 - 104.00	36.00 - 36.50	3.991	.165	96.96	4.164	.226	160.08
2734	103.50 - 104.00	36.50 - 37.00	4.013	.163	108.08	4.177	.228	145.24
2735	103.50 - 104.00	37.00 - 37.50	4.010	.167	118.68	4.177	.228	132.51
2736	103.50 - 104.00	37.50 - 38.00	4.006	.163	128.17	4.179	.228	135.37
2737	103.50 - 104.00	38.00 - 38.50	4.006	.163	136.88	4.179	.228	126.00
2738	103.50 - 104.00	38.50 - 39.00	3.714	.177	111.42	4.197	.233	108.65
2739	103.50 - 104.00	39.00 - 39.50	3.631	.155	109.33	4.200	.238	86.60
2740	103.50 - 104.00	39.50 - 40.00	3.537	.171	100.89	4.210	.241	78.12
2741	103.50 - 104.00	40.00 - 40.50	3.372	.286	83.80	4.210	.241	86.49
2742	103.50 - 104.00	40.50 - 41.00	3.350	.268	85.17	4.203	.243	110.33
2743	103.50 - 104.00	41.00 - 41.50	3.342	.265	89.41	4.143	.230	130.00
2744	103.50 - 104.00	41.50 - 42.00	3.309	.241	87.85	4.168	.211	163.09
2745	103.50 - 104.00	42.00 - 42.50	3.292	.237	79.99	4.154	.220	180.96
2746	103.50 - 104.00	42.50 - 43.00	3.157	.124	57.23	4.142	.219	193.38
2747	103.50 - 104.00	43.00 - 43.50	3.418	.079	93.08	4.148	.221	203.94
2748	103.50 - 104.00	43.50 - 44.00	3.402	.094	86.07	4.114	.230	203.67
2749	103.50 - 104.00	44.00 - 44.50	3.389	.108	54.96	3.748	.212	146.14
2750	103.50 - 104.00	44.50 - 45.00	3.389	.108	114.42	3.554	.225	145.52
2751	103.50 - 104.00	45.00 - 45.50	3.371	.126	142.13	3.535	.239	173.27
2752	103.50 - 104.00	45.50 - 46.00	3.371	.126	157.60	3.535	.239	198.15
2753	103.50 - 104.00	46.00 - 46.50	3.306	.396	139.92	3.515	.256	214.92
2754	103.50 - 104.00	46.50 - 47.00	3.306	.396	135.89	3.515	.256	229.32
2755	103.50 - 104.00	47.00 - 47.50	3.285	.392	123.07	3.385	.231	216.66
2756	103.50 - 104.00	47.50 - 48.00	3.222	.391	98.97	3.333	.221	217.66
2757	103.50 - 104.00	48.00 - 48.50	3.183	.416	73.42	2.940	.316	170.51
2758	103.50 - 104.00	48.50 - 49.00	3.046	.489	49.63	2.896	.343	177.74
2759	103.50 - 104.00	49.00 - 49.50	2.993	.552	49.42	2.821	.411	187.25
2760	103.50 - 104.00	49.50 - 50.00	2.993	.552	51.29	2.746	.503	196.25
2761	104.00 - 104.50	28.00 - 28.50	3.262	.462	159.89	3.199	.209	76.75
2762	104.00 - 104.50	28.50 - 29.00	3.262	.462	126.40	3.199	.209	24.88
2763	104.00 - 104.50	29.00 - 29.50	3.262	.462	93.02	3.225	.226	69.56
2764	104.00 - 104.50	29.50 - 30.00	3.262	.462	60.58	3.225	.226	76.80
2765	104.00 - 104.50	30.00 - 30.50	3.262	.462	33.79	3.199	.209	72.56

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
2766	104.00 - 104.50	30.50 - 31.00	3.262	.462	10.58	3.199	.209	80.69
2767	104.00 - 104.50	31.00 - 31.50	3.262	.462	37.41	3.199	.209	97.50
2768	104.00 - 104.50	31.50 - 32.00	3.328	.430	75.30	3.199	.209	118.01
2769	104.00 - 104.50	32.00 - 32.50	3.760	.158	147.07	3.268	.156	153.69
2770	104.00 - 104.50	32.50 - 33.00	3.835	.149	160.39	3.326	.142	172.22
2771	104.00 - 104.50	33.00 - 33.50	3.981	.204	170.68	3.114	.188	177.54
2772	104.00 - 104.50	33.50 - 34.00	4.301	.206	163.80	3.236	.123	166.51
2773	104.00 - 104.50	34.00 - 34.50	4.304	.201	146.81	3.620	.180	176.80
2774	104.00 - 104.50	34.50 - 35.00	4.308	.196	136.49	3.780	.139	171.97
2775	104.00 - 104.50	35.00 - 35.50	4.312	.191	136.79	3.783	.133	151.77
2776	104.00 - 104.50	35.50 - 36.00	4.321	.190	134.55	3.783	.133	133.36
2777	104.00 - 104.50	36.00 - 36.50	4.339	.183	124.80	3.783	.133	110.80
2778	104.00 - 104.50	36.50 - 37.00	4.343	.178	150.33	3.835	.140	54.33
2779	104.00 - 104.50	37.00 - 37.50	4.019	.133	141.86	4.089	.218	47.88
2780	104.00 - 104.50	37.50 - 38.00	3.927	.116	154.82	4.121	.218	114.53
2781	104.00 - 104.50	38.00 - 38.50	3.792	.136	153.01	4.112	.209	112.43
2782	104.00 - 104.50	38.50 - 39.00	3.523	.124	124.12	4.108	.211	84.83
2783	104.00 - 104.50	39.00 - 39.50	3.468	.074	111.72	4.099	.215	44.03
2784	104.00 - 104.50	39.50 - 40.00	3.449	.073	96.03	4.015	.209	33.79
2785	104.00 - 104.50	40.00 - 40.50	3.487	.132	89.43	4.030	.222	39.39
2786	104.00 - 104.50	40.50 - 41.00	3.515	.179	103.79	4.027	.226	75.44
2787	104.00 - 104.50	41.00 - 41.50	3.486	.116	117.55	4.053	.229	112.21
2788	104.00 - 104.50	41.50 - 42.00	3.525	.056	130.12	4.060	.223	142.90
2789	104.00 - 104.50	42.00 - 42.50	3.525	.056	127.34	4.022	.229	163.38
2790	104.00 - 104.50	42.50 - 43.00	3.525	.056	121.47	3.480	.210	135.29
2791	104.00 - 104.50	43.00 - 43.50	3.390	.020	114.04	3.285	.188	105.44
2792	104.00 - 104.50	43.50 - 44.00	3.357	.013	103.83	3.251	.213	89.77
2793	104.00 - 104.50	44.00 - 44.50	3.357	.013	85.08	3.251	.213	85.22
2794	104.00 - 104.50	44.50 - 45.00	3.317	.053	122.13	3.251	.213	101.87
2795	104.00 - 104.50	45.00 - 45.50	3.317	.053	170.58	3.446	.278	149.33
2796	104.00 - 104.50	45.50 - 46.00	3.129	.060	183.03	3.302	.243	160.32
2797	104.00 - 104.50	46.00 - 46.50	3.187	.022	178.18	3.302	.243	175.64
2798	104.00 - 104.50	46.50 - 47.00	3.089	.076	155.64	2.940	.316	146.94
2799	104.00 - 104.50	47.00 - 47.50	3.016	.149	119.39	2.746	.503	121.42
2800	104.00 - 104.50	47.50 - 48.00	3.378	.552	113.67	2.746	.503	116.41

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2801	104.00 - 104.50	48.00 - 48.50	3.378	.552	68.90	2.746	.503	121.42
2802	104.00 - 104.50	48.50 - 49.00	3.378	.552	41.07	2.746	.503	135.33
2803	104.00 - 104.50	49.00 - 49.50	3.378	.552	62.72	2.746	.503	155.77
2804	104.00 - 104.50	49.50 - 50.00	3.378	.552	68.35	2.746	.503	180.54
2805	104.50 - 105.00	28.00 - 28.50	3.262	.462	160.59	3.199	.209	86.80
2806	104.50 - 105.00	28.50 - 29.00	3.262	.462	126.89	3.199	.209	63.25
2807	104.50 - 105.00	29.00 - 29.50	3.262	.462	92.66	3.225	.226	66.25
2808	104.50 - 105.00	29.50 - 30.00	3.262	.462	56.27	3.225	.226	56.62
2809	104.50 - 105.00	30.00 - 30.50	3.262	.462	19.29	3.199	.209	43.64
2810	104.50 - 105.00	30.50 - 31.00	3.262	.462	30.98	3.199	.209	57.38
2811	104.50 - 105.00	31.00 - 31.50	3.262	.462	47.51	3.199	.209	79.44
2812	104.50 - 105.00	31.50 - 32.00	4.097	.299	149.25	3.199	.209	101.73
2813	104.50 - 105.00	32.00 - 32.50	4.203	.248	174.39	3.268	.156	136.14
2814	104.50 - 105.00	32.50 - 33.00	4.240	.225	167.67	3.326	.142	156.96
2815	104.50 - 105.00	33.00 - 33.50	4.296	.250	158.02	3.114	.188	158.11
2816	104.50 - 105.00	33.50 - 34.00	4.259	.220	135.18	3.221	.144	148.78
2817	104.50 - 105.00	34.00 - 34.50	4.263	.215	113.34	3.616	.183	159.30
2818	104.50 - 105.00	34.50 - 35.00	4.267	.210	92.91	3.777	.144	153.38
2819	104.50 - 105.00	35.00 - 35.50	4.271	.206	107.58	3.787	.137	132.81
2820	104.50 - 105.00	35.50 - 36.00	4.302	.202	113.07	3.809	.141	117.87
2821	104.50 - 105.00	36.00 - 36.50	4.322	.191	56.70	3.815	.140	106.70
2822	104.50 - 105.00	36.50 - 37.00	4.326	.186	113.18	3.909	.140	99.55
2823	104.50 - 105.00	37.00 - 37.50	3.983	.153	113.87	4.127	.224	104.62
2824	104.50 - 105.00	37.50 - 38.00	3.877	.163	126.09	4.155	.227	118.70
2825	104.50 - 105.00	38.00 - 38.50	3.825	.145	130.73	4.146	.220	109.24
2826	104.50 - 105.00	38.50 - 39.00	3.621	.210	109.58	4.144	.220	82.09
2827	104.50 - 105.00	39.00 - 39.50	3.586	.180	101.13	4.138	.223	46.36
2828	104.50 - 105.00	39.50 - 40.00	3.572	.182	79.03	4.064	.214	13.07
2829	104.50 - 105.00	40.00 - 40.50	3.593	.215	56.44	4.094	.216	30.98
2830	104.50 - 105.00	40.50 - 41.00	3.576	.221	81.30	4.087	.223	73.14
2831	104.50 - 105.00	41.00 - 41.50	3.425	.060	93.67	4.105	.228	112.22
2832	104.50 - 105.00	41.50 - 42.00	3.422	.001	98.27	4.108	.224	143.86
2833	104.50 - 105.00	42.00 - 42.50	3.422	.001	111.22	4.038	.229	160.39
2834	104.50 - 105.00	42.50 - 43.00	3.422	.001	125.77	3.543	.197	132.82
2835	104.50 - 105.00	43.00 - 43.50	3.213	.145	114.03	3.372	.184	98.89

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
2836	104.50 - 105.00	43.50 - 44.00	3.175	.106	110.60	3.346	.200	78.29
2837	104.50 - 105.00	44.00 - 44.50	3.175	.106	108.64	3.346	.200	65.14
2838	104.50 - 105.00	44.50 - 45.00	3.129	.060	123.39	3.317	.220	92.36
2839	104.50 - 105.00	45.00 - 45.50	3.357	.013	173.65	3.446	.278	141.77
2840	104.50 - 105.00	45.50 - 46.00	3.175	.106	176.09	3.302	.243	153.02
2841	104.50 - 105.00	46.00 - 46.50	3.232	.066	174.23	3.302	.243	165.51
2842	104.50 - 105.00	46.50 - 47.00	3.089	.076	151.98	2.940	.316	129.92
2843	104.50 - 105.00	47.00 - 47.50	3.016	.149	116.17	2.746	.503	99.50
2844	104.50 - 105.00	47.50 - 48.00	3.378	.552	108.58	2.746	.503	93.32
2845	104.50 - 105.00	48.00 - 48.50	3.378	.552	58.83	2.746	.503	99.50
2846	104.50 - 105.00	48.50 - 49.00	3.378	.552	16.86	2.746	.503	116.06
2847	104.50 - 105.00	49.00 - 49.50	3.378	.552	53.64	2.746	.503	139.36
2848	104.50 - 105.00	49.50 - 50.00	3.378	.552	53.41	2.746	.503	166.59
2849	105.00 - 105.50	28.00 - 28.50	3.262	.462	166.46	3.350	.130	106.03
2850	105.00 - 105.50	28.50 - 29.00	3.262	.462	134.03	3.350	.130	78.03
2851	105.00 - 105.50	29.00 - 29.50	3.262	.462	101.88	3.368	.135	57.94
2852	105.00 - 105.50	29.50 - 30.00	3.262	.462	70.65	3.368	.135	47.69
2853	105.00 - 105.50	30.00 - 30.50	3.262	.462	50.21	3.350	.130	18.52
2854	105.00 - 105.50	30.50 - 31.00	3.262	.462	54.82	3.350	.130	47.25
2855	105.00 - 105.50	31.00 - 31.50	3.262	.462	68.14	3.350	.130	75.89
2856	105.00 - 105.50	31.50 - 32.00	4.097	.299	159.72	3.350	.130	99.53
2857	105.00 - 105.50	32.00 - 32.50	4.203	.248	167.80	3.268	.156	118.71
2858	105.00 - 105.50	32.50 - 33.00	4.240	.225	153.07	3.326	.142	143.34
2859	105.00 - 105.50	33.00 - 33.50	4.296	.250	138.58	3.114	.188	140.59
2860	105.00 - 105.50	33.50 - 34.00	4.263	.215	114.18	3.221	.144	130.89
2861	105.00 - 105.50	34.00 - 34.50	4.267	.210	91.05	3.616	.183	140.48
2862	105.00 - 105.50	34.50 - 35.00	4.271	.206	39.85	3.777	.144	133.39
2863	105.00 - 105.50	35.00 - 35.50	4.275	.201	85.17	3.799	.134	110.36
2864	105.00 - 105.50	35.50 - 36.00	4.302	.202	100.39	3.821	.139	88.80
2865	105.00 - 105.50	36.00 - 36.50	4.322	.191	100.29	3.826	.139	86.28
2866	105.00 - 105.50	36.50 - 37.00	4.326	.186	56.83	3.918	.138	99.25
2867	105.00 - 105.50	37.00 - 37.50	3.983	.153	97.21	4.132	.224	116.21
2868	105.00 - 105.50	37.50 - 38.00	3.877	.163	110.24	4.160	.227	117.91
2869	105.00 - 105.50	38.00 - 38.50	3.825	.145	110.14	4.152	.220	106.93
2870	105.00 - 105.50	38.50 - 39.00	3.621	.210	88.06	4.149	.220	83.52

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2871	105.00 - 105.50	39.00 - 39.50	3.586	.180	85.68	4.144	.223	53.13
2872	105.00 - 105.50	39.50 - 40.00	3.572	.182	64.73	4.071	.212	22.81
2873	105.00 - 105.50	40.00 - 40.50	3.593	.215	20.95	4.070	.209	47.20
2874	105.00 - 105.50	40.50 - 41.00	3.576	.221	66.96	4.053	.220	76.18
2875	105.00 - 105.50	41.00 - 41.50	3.429	.059	77.81	4.072	.227	110.26
2876	105.00 - 105.50	41.50 - 42.00	3.428	.007	61.84	4.074	.223	139.66
2877	105.00 - 105.50	42.00 - 42.50	3.428	.007	91.30	3.996	.233	153.80
2878	105.00 - 105.50	42.50 - 43.00	3.428	.007	124.06	3.425	.149	111.97
2879	105.00 - 105.50	43.00 - 43.50	3.220	.152	118.87	3.280	.183	74.44
2880	105.00 - 105.50	43.50 - 44.00	3.183	.115	119.43	3.240	.198	46.96
2881	105.00 - 105.50	44.00 - 44.50	3.183	.115	119.40	3.240	.198	25.36
2882	105.00 - 105.50	44.50 - 45.00	3.139	.070	124.78	3.195	.218	71.81
2883	105.00 - 105.50	45.00 - 45.50	3.175	.106	142.49	3.491	.274	140.09
2884	105.00 - 105.50	45.50 - 46.00	3.209	.000	177.84	3.358	.249	152.62
2885	105.00 - 105.50	46.00 - 46.50	3.232	.066	169.79	3.302	.243	156.36
2886	105.00 - 105.50	46.50 - 47.00	3.089	.076	151.12	2.940	.316	113.21
2887	105.00 - 105.50	47.00 - 47.50	3.016	.149	117.87	2.746	.503	78.31
2888	105.00 - 105.50	47.50 - 48.00	3.378	.552	113.02	2.746	.503	70.30
2889	105.00 - 105.50	48.00 - 48.50	3.378	.552	68.58	2.746	.503	78.31
2890	105.00 - 105.50	48.50 - 49.00	3.378	.552	40.88	2.746	.503	98.51
2891	105.00 - 105.50	49.00 - 49.50	3.378	.552	59.60	2.746	.503	125.12
2892	105.00 - 105.50	49.50 - 50.00	3.378	.552	46.87	2.746	.503	154.88
2893	105.50 - 106.00	28.00 - 28.50	3.262	.462	177.11	3.329	.128	105.23
2894	105.50 - 106.00	28.50 - 29.00	3.262	.462	147.11	3.329	.128	67.52
2895	105.50 - 106.00	29.00 - 29.50	3.262	.462	118.96	3.350	.130	22.80
2896	105.50 - 106.00	29.50 - 30.00	3.262	.462	95.11	3.350	.130	42.10
2897	105.50 - 106.00	30.00 - 30.50	3.300	.440	83.95	3.350	.130	14.77
2898	105.50 - 106.00	30.50 - 31.00	3.300	.440	83.89	3.350	.130	30.14
2899	105.50 - 106.00	31.00 - 31.50	3.300	.440	93.80	3.350	.130	66.93
2900	105.50 - 106.00	31.50 - 32.00	4.104	.291	166.26	3.350	.130	73.48
2901	105.50 - 106.00	32.00 - 32.50	4.208	.241	159.91	3.268	.156	97.90
2902	105.50 - 106.00	32.50 - 33.00	4.245	.220	138.89	3.326	.142	132.25
2903	105.50 - 106.00	33.00 - 33.50	4.300	.244	119.85	3.114	.188	125.70
2904	105.50 - 106.00	33.50 - 34.00	4.274	.213	94.64	3.236	.123	112.67
2905	105.50 - 106.00	34.00 - 34.50	4.278	.208	78.32	3.620	.180	119.47

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2906	105.50 - 106.00	34.50 - 35.00	4.282	.204	66.33	3.780	.139	112.70
2907	105.50 - 106.00	35.00 - 35.50	4.285	.200	62.97	3.799	.134	89.43
2908	105.50 - 106.00	35.50 - 36.00	4.311	.202	79.44	3.821	.139	43.02
2909	105.50 - 106.00	36.00 - 36.50	4.322	.191	101.19	3.826	.139	47.30
2910	105.50 - 106.00	36.50 - 37.00	4.326	.186	106.11	3.918	.138	81.00
2911	105.50 - 106.00	37.00 - 37.50	3.983	.153	84.10	4.132	.224	103.83
2912	105.50 - 106.00	37.50 - 38.00	3.877	.163	93.72	4.169	.231	110.82
2913	105.50 - 106.00	38.00 - 38.50	3.825	.145	87.77	4.161	.224	105.07
2914	105.50 - 106.00	38.50 - 39.00	3.621	.210	57.68	4.158	.224	85.90
2915	105.50 - 106.00	39.00 - 39.50	3.586	.180	69.76	4.153	.227	62.79
2916	105.50 - 106.00	39.50 - 40.00	3.572	.182	69.85	4.083	.216	49.93
2917	105.50 - 106.00	40.00 - 40.50	3.593	.215	54.58	4.086	.212	64.71
2918	105.50 - 106.00	40.50 - 41.00	3.576	.221	75.78	4.082	.222	87.90
2919	105.50 - 106.00	41.00 - 41.50	3.429	.059	69.46	4.095	.231	115.90
2920	105.50 - 106.00	41.50 - 42.00	3.428	.007	24.01	4.097	.228	141.63
2921	105.50 - 106.00	42.00 - 42.50	3.428	.007	78.39	4.022	.239	151.24
2922	105.50 - 106.00	42.50 - 43.00	3.428	.007	121.95	3.520	.184	106.71
2923	105.50 - 106.00	43.00 - 43.50	3.220	.152	119.07	3.321	.226	64.33
2924	105.50 - 106.00	43.50 - 44.00	3.183	.115	118.26	3.282	.245	21.27
2925	105.50 - 106.00	44.00 - 44.50	3.183	.115	112.86	3.282	.245	50.86
2926	105.50 - 106.00	44.50 - 45.00	3.139	.070	110.23	3.236	.268	79.23
2927	105.50 - 106.00	45.00 - 45.50	3.359	.061	145.46	3.370	.230	124.90
2928	105.50 - 106.00	45.50 - 46.00	3.197	.031	150.42	3.358	.249	148.89
2929	105.50 - 106.00	46.00 - 46.50	3.197	.031	161.05	3.302	.243	148.86
2930	105.50 - 106.00	46.50 - 47.00	3.089	.076	152.50	2.940	.316	98.17
2931	105.50 - 106.00	47.00 - 47.50	3.016	.149	123.82	2.746	.503	58.67
2932	105.50 - 106.00	47.50 - 48.00	3.378	.552	125.14	2.746	.503	47.46
2933	105.50 - 106.00	48.00 - 48.50	3.378	.552	89.75	2.746	.503	58.67
2934	105.50 - 106.00	48.50 - 49.00	3.378	.552	71.34	2.746	.503	83.75
2935	105.50 - 106.00	49.00 - 49.50	3.378	.552	72.91	2.746	.503	113.86
2936	105.50 - 106.00	49.50 - 50.00	3.378	.552	54.79	2.746	.503	145.93
2937	106.00 - 106.50	30.00 - 30.50	3.300	.440	112.68	3.350	.130	42.49
2938	106.00 - 106.50	30.50 - 31.00	3.464	.296	127.12	3.350	.130	54.85
2939	106.00 - 106.50	31.00 - 31.50	3.464	.296	132.13	3.350	.130	68.57
2940	106.00 - 106.50	31.50 - 32.00	4.125	.280	168.08	3.350	.130	28.93

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Θ(H)	R(H)	A(N)	Θ(N)	R(N)
2941	106.00 - 106.50	32.00 - 32.50	4.223	.235	152.27	3.287	.137	85.21
2942	106.00 - 106.50	32.50 - 33.00	4.257	.216	126.69	3.337	.132	127.72
2943	106.00 - 106.50	33.00 - 33.50	4.302	.243	102.25	3.136	.157	115.84
2944	106.00 - 106.50	33.50 - 34.00	4.285	.204	74.10	3.236	.123	91.68
2945	106.00 - 106.50	34.00 - 34.50	4.270	.210	55.92	3.620	.180	88.23
2946	106.00 - 106.50	34.50 - 35.00	4.273	.205	48.69	3.780	.139	89.83
2947	106.00 - 106.50	35.00 - 35.50	4.277	.201	26.79	3.799	.134	66.51
2948	106.00 - 106.50	35.50 - 36.00	4.304	.202	45.51	3.821	.139	65.04
2949	106.00 - 106.50	36.00 - 36.50	4.315	.192	90.31	3.826	.139	32.24
2950	106.00 - 106.50	36.50 - 37.00	4.318	.187	109.31	3.920	.135	60.90
2951	106.00 - 106.50	37.00 - 37.50	3.971	.144	40.03	4.134	.223	80.45
2952	106.00 - 106.50	37.50 - 38.00	3.860	.153	77.66	4.175	.234	97.61
2953	106.00 - 106.50	38.00 - 38.50	3.804	.138	68.93	4.167	.227	101.03
2954	106.00 - 106.50	38.50 - 39.00	3.586	.180	22.41	4.165	.227	84.12
2955	106.00 - 106.50	39.00 - 39.50	3.600	.181	53.58	4.160	.229	39.23
2956	106.00 - 106.50	39.50 - 40.00	3.586	.180	72.74	4.091	.218	48.35
2957	106.00 - 106.50	40.00 - 40.50	3.608	.211	80.51	4.097	.213	75.21
2958	106.00 - 106.50	40.50 - 41.00	3.633	.245	88.44	4.093	.222	89.91
2959	106.00 - 106.50	41.00 - 41.50	3.519	.124	82.44	4.105	.231	118.26
2960	106.00 - 106.50	41.50 - 42.00	3.576	.037	70.36	4.107	.228	142.51
2961	106.00 - 106.50	42.00 - 42.50	3.576	.037	101.49	4.031	.243	144.97
2962	106.00 - 106.50	42.50 - 43.00	3.576	.037	132.03	3.551	.202	87.03
2963	106.00 - 106.50	43.00 - 43.50	3.455	.035	130.14	3.321	.226	61.73
2964	106.00 - 106.50	43.50 - 44.00	3.428	.007	125.65	3.282	.245	40.65
2965	106.00 - 106.50	44.00 - 44.50	3.428	.007	113.22	3.282	.245	60.03
2966	106.00 - 106.50	44.50 - 45.00	3.359	.061	99.26	3.236	.268	85.82
2967	106.00 - 106.50	45.00 - 45.50	3.359	.061	118.58	3.375	.202	124.14
2968	106.00 - 106.50	45.50 - 46.00	3.197	.031	133.86	3.365	.216	144.24
2969	106.00 - 106.50	46.00 - 46.50	3.197	.031	156.07	3.310	.207	141.25
2970	106.00 - 106.50	46.50 - 47.00	3.089	.076	155.53	3.016	.241	92.06
2971	106.00 - 106.50	47.00 - 47.50	3.016	.149	132.78	2.896	.343	49.57
2972	106.00 - 106.50	47.50 - 48.00	3.378	.552	141.56	2.821	.411	27.27
2973	106.00 - 106.50	48.00 - 48.50	3.378	.552	112.85	2.746	.503	42.76
2974	106.00 - 106.50	48.50 - 49.00	3.378	.552	96.65	2.746	.503	73.48
2975	106.00 - 106.50	49.00 - 49.50	3.378	.552	88.87	2.746	.503	106.54

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	σ(N)	R(N)
2976	106.00 - 106.50	49.50 - 50.00	3.378	.552	72.51	2.746	.503	140.29
2977	106.50 - 107.00	30.00 - 30.50	3.604	.530	163.17	3.350	.130	70.52
2978	106.50 - 107.00	30.50 - 31.00	3.710	.418	167.83	3.350	.130	78.22
2979	106.50 - 107.00	31.00 - 31.50	3.710	.418	165.06	3.350	.130	85.32
2980	106.50 - 107.00	31.50 - 32.00	4.175	.269	167.13	3.350	.130	77.26
2981	106.50 - 107.00	32.00 - 32.50	4.251	.224	146.28	3.287	.137	102.93
2982	106.50 - 107.00	32.50 - 33.00	4.278	.206	118.68	3.337	.132	132.20
2983	106.50 - 107.00	33.00 - 33.50	4.311	.230	89.63	3.136	.157	112.14
2984	106.50 - 107.00	33.50 - 34.00	4.287	.203	54.74	3.221	.144	77.46
2985	106.50 - 107.00	34.00 - 34.50	4.272	.209	28.67	3.616	.183	37.42
2986	106.50 - 107.00	34.50 - 35.00	4.276	.205	22.25	3.777	.144	75.47
2987	106.50 - 107.00	35.00 - 35.50	4.279	.201	39.34	3.796	.139	26.63
2988	106.50 - 107.00	35.50 - 36.00	4.305	.202	33.04	3.821	.139	64.28
2989	106.50 - 107.00	36.00 - 36.50	4.317	.191	86.32	3.826	.139	50.40
2990	106.50 - 107.00	36.50 - 37.00	4.320	.187	113.63	3.920	.135	33.91
2991	106.50 - 107.00	37.00 - 37.50	3.974	.146	78.53	4.134	.223	45.32
2992	106.50 - 107.00	37.50 - 38.00	3.865	.155	64.05	4.176	.233	81.24
2993	106.50 - 107.00	38.00 - 38.50	3.809	.139	53.71	4.169	.226	94.19
2994	106.50 - 107.00	38.50 - 39.00	3.586	.180	44.80	4.166	.226	83.84
2995	106.50 - 107.00	39.00 - 39.50	3.600	.181	27.34	4.162	.227	45.09
2996	106.50 - 107.00	39.50 - 40.00	3.586	.180	69.64	4.094	.214	71.46
2997	106.50 - 107.00	40.00 - 40.50	3.572	.182	79.44	4.101	.207	53.42
2998	106.50 - 107.00	40.50 - 41.00	3.601	.221	68.19	4.097	.217	56.09
2999	106.50 - 107.00	41.00 - 41.50	3.449	.073	78.95	4.107	.228	117.38
3000	106.50 - 107.00	41.50 - 42.00	3.462	.004	93.16	4.107	.228	140.21
3001	106.50 - 107.00	42.00 - 42.50	3.462	.004	107.20	4.036	.237	137.89
3002	106.50 - 107.00	42.50 - 43.00	3.462	.004	118.87	3.569	.181	43.83
3003	106.50 - 107.00	43.00 - 43.50	3.282	.116	101.72	3.350	.188	59.22
3004	106.50 - 107.00	43.50 - 44.00	3.247	.082	92.36	3.314	.205	21.90
3005	106.50 - 107.00	44.00 - 44.50	3.247	.082	73.87	3.314	.205	61.36
3006	106.50 - 107.00	44.50 - 45.00	3.155	.010	46.65	3.273	.227	90.65
3007	106.50 - 107.00	45.00 - 45.50	3.359	.061	90.32	3.478	.135	128.05
3008	106.50 - 107.00	45.50 - 46.00	3.197	.031	120.05	3.472	.144	144.53
3009	106.50 - 107.00	46.00 - 46.50	3.197	.031	152.46	3.429	.118	143.27
3010	106.50 - 107.00	46.50 - 47.00	3.089	.076	159.99	3.201	.172	100.71

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3C11	106.50 - 107.00	47.00 - 47.50	3.016	.149	143.54	3.146	.188	53.37
3C12	106.50 - 107.00	47.50 - 48.00	3.378	.552	159.82	2.940	.316	12.20
3C13	106.50 - 107.00	48.00 - 48.50	3.378	.552	134.97	2.896	.375	41.81
3C14	106.50 - 107.00	48.50 - 49.00	3.378	.552	118.70	2.746	.503	69.72
3C15	106.50 - 107.00	49.00 - 49.50	3.378	.552	107.12	2.746	.503	103.98
3C16	106.50 - 107.00	49.50 - 50.00	3.378	.552	93.97	2.746	.503	138.36
3C17	107.00 - 107.50	30.00 - 30.50	3.275	.627	144.81	3.329	.128	86.08
3C18	107.00 - 107.50	30.50 - 31.00	3.463	.457	149.07	3.329	.128	97.10
3C19	107.00 - 107.50	31.00 - 31.50	3.463	.457	137.87	3.329	.128	106.53
3C20	107.00 - 107.50	31.50 - 32.00	4.124	.251	157.76	3.350	.130	115.55
3C21	107.00 - 107.50	32.00 - 32.50	4.206	.204	135.40	3.287	.137	131.51
3C22	107.00 - 107.50	32.50 - 33.00	4.234	.186	108.48	3.337	.132	143.40
3C23	107.00 - 107.50	33.00 - 33.50	4.283	.208	82.06	3.136	.157	117.91
3C24	107.00 - 107.50	33.50 - 34.00	4.306	.193	46.47	3.314	.172	98.10
3C25	107.00 - 107.50	34.00 - 34.50	4.297	.195	13.48	3.642	.199	89.51
3C26	107.00 - 107.50	34.50 - 35.00	4.300	.190	40.23	3.794	.150	91.02
3C27	107.00 - 107.50	35.00 - 35.50	4.304	.186	61.19	3.812	.145	68.58
3C28	107.00 - 107.50	35.50 - 36.00	4.329	.186	73.20	3.821	.139	71.13
3C29	107.00 - 107.50	36.00 - 36.50	4.338	.180	100.93	3.826	.139	46.73
3C30	107.00 - 107.50	36.50 - 37.00	4.341	.175	123.40	3.943	.133	16.22
3C31	107.00 - 107.50	37.00 - 37.50	3.974	.146	84.55	4.168	.222	27.18
3C32	107.00 - 107.50	37.50 - 38.00	3.865	.155	33.63	4.208	.232	71.30
3C33	107.00 - 107.50	38.00 - 38.50	3.809	.139	23.89	4.201	.225	80.86
3C34	107.00 - 107.50	38.50 - 39.00	3.586	.180	45.69	4.198	.225	80.71
3C35	107.00 - 107.50	39.00 - 39.50	3.600	.181	57.72	4.195	.225	49.00
3C36	107.00 - 107.50	39.50 - 40.00	3.586	.180	77.37	4.141	.207	81.67
3C37	107.00 - 107.50	40.00 - 40.50	3.572	.182	75.88	4.163	.184	66.47
3C38	107.00 - 107.50	40.50 - 41.00	3.601	.221	28.45	4.161	.190	101.85
3C39	107.00 - 107.50	41.00 - 41.50	3.449	.073	73.73	4.172	.199	125.99
3C40	107.00 - 107.50	41.50 - 42.00	3.439	.028	100.80	4.173	.197	125.96
3C41	107.00 - 107.50	42.00 - 42.50	3.439	.028	109.90	4.101	.214	140.28
3C42	107.00 - 107.50	42.50 - 43.00	3.439	.028	109.89	3.639	.173	88.17
3C43	107.00 - 107.50	43.00 - 43.50	3.255	.089	84.51	3.526	.112	72.07
3C44	107.00 - 107.50	43.50 - 44.00	3.215	.049	72.45	3.507	.112	50.47
3C45	107.00 - 107.50	44.00 - 44.50	3.215	.049	58.85	3.507	.112	75.20

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3C46	107.00 - 107.50	44.50 - 45.00	3.104	.061	17.27	3.487	.114	105.33
3C47	107.00 - 107.50	45.00 - 45.50	3.791	.153	106.17	3.648	.153	129.74
3C48	107.00 - 107.50	45.50 - 46.00	3.791	.153	157.49	3.623	.146	141.59
3C49	107.00 - 107.50	46.00 - 46.50	3.791	.153	188.59	3.571	.129	143.66
3C50	107.00 - 107.50	46.50 - 47.00	3.687	.177	202.27	3.430	.131	119.43
3C51	107.00 - 107.50	47.00 - 47.50	3.589	.178	202.77	3.398	.129	79.20
3C52	107.00 - 107.50	47.50 - 48.00	3.430	.489	182.39	3.146	.242	37.90
3C53	107.00 - 107.50	48.00 - 48.50	3.378	.552	156.15	2.896	.375	49.69
3C54	107.00 - 107.50	48.50 - 49.00	3.378	.552	139.74	2.746	.503	73.48
3C55	107.00 - 107.50	49.00 - 49.50	3.378	.552	127.23	2.746	.503	106.54
3C56	107.00 - 107.50	49.50 - 50.00	3.378	.552	116.80	2.746	.503	140.29
3C57	107.50 - 108.00	30.00 - 30.50	3.222	.666	125.72	3.394	.126	101.01
3C58	107.50 - 108.00	30.50 - 31.00	3.430	.489	124.23	3.394	.126	119.69
3C59	107.50 - 108.00	31.00 - 31.50	3.430	.489	111.23	3.394	.126	132.16
3C60	107.50 - 108.00	31.50 - 32.00	4.148	.242	150.11	3.412	.124	143.36
3C61	107.50 - 108.00	32.00 - 32.50	4.225	.197	127.20	3.210	.207	134.32
3C62	107.50 - 108.00	32.50 - 33.00	4.252	.177	98.60	3.419	.130	159.09
3C63	107.50 - 108.00	33.00 - 33.50	4.302	.197	85.79	3.240	.198	134.40
3C64	107.50 - 108.00	33.50 - 34.00	4.306	.193	58.35	3.369	.131	119.96
3C65	107.50 - 108.00	34.00 - 34.50	4.297	.195	39.40	3.655	.197	117.15
3C66	107.50 - 108.00	34.50 - 35.00	4.300	.190	55.39	3.787	.137	110.58
3C67	107.50 - 108.00	35.00 - 35.50	4.304	.186	77.72	3.805	.133	96.28
3C68	107.50 - 108.00	35.50 - 36.00	4.329	.186	97.49	3.813	.129	82.09
3C69	107.50 - 108.00	36.00 - 36.50	4.338	.180	118.05	3.813	.129	57.17
3C70	107.50 - 108.00	36.50 - 37.00	4.341	.175	133.21	3.933	.124	42.91
3C71	107.50 - 108.00	37.00 - 37.50	3.974	.146	93.13	4.164	.219	58.77
3C72	107.50 - 108.00	37.50 - 38.00	3.865	.155	55.20	4.203	.229	53.36
3C73	107.50 - 108.00	38.00 - 38.50	3.818	.132	18.97	4.196	.222	41.88
3C74	107.50 - 108.00	38.50 - 39.00	3.600	.181	46.27	4.194	.221	55.87
3C75	107.50 - 108.00	39.00 - 39.50	3.612	.183	72.97	4.193	.220	40.84
3C76	107.50 - 108.00	39.50 - 40.00	3.600	.181	89.15	4.140	.199	85.57
3C77	107.50 - 108.00	40.00 - 40.50	3.586	.180	88.13	4.177	.175	99.85
3C78	107.50 - 108.00	40.50 - 41.00	3.616	.218	71.57	4.182	.176	116.67
3C79	107.50 - 108.00	41.00 - 41.50	3.549	.137	91.20	4.192	.186	127.43
3C80	107.50 - 108.00	41.50 - 42.00	3.687	.080	123.06	4.196	.182	65.85

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3081	107.50 - 108.00	42.00 - 42.50	3.876	.134	143.43	4.145	.200	136.53
3082	107.50 - 108.00	42.50 - 43.00	3.890	.120	133.75	3.756	.207	102.28
3083	107.50 - 108.00	43.00 - 43.50	3.843	.101	107.31	3.745	.097	83.33
3084	107.50 - 108.00	43.50 - 44.00	3.812	.132	79.84	3.735	.090	33.51
3085	107.50 - 108.00	44.00 - 44.50	3.812	.132	94.17	3.735	.090	87.58
3086	107.50 - 108.00	44.50 - 45.00	3.775	.168	78.55	3.713	.093	114.01
3087	107.50 - 108.00	45.00 - 45.50	4.265	.356	143.14	3.876	.274	127.25
3088	107.50 - 108.00	45.50 - 46.00	4.255	.359	163.89	3.834	.252	134.93
3089	107.50 - 108.00	46.00 - 46.50	4.244	.363	177.53	3.779	.223	141.32
3090	107.50 - 108.00	46.50 - 47.00	4.218	.373	191.20	3.706	.201	138.12
3091	107.50 - 108.00	47.00 - 47.50	4.203	.381	206.13	3.693	.194	123.93
3092	107.50 - 108.00	47.50 - 48.00	3.996	.297	198.38	3.317	.114	81.09
3093	107.50 - 108.00	48.00 - 48.50	3.930	.357	202.84	3.132	.202	83.97
3094	107.50 - 108.00	48.50 - 49.00	3.918	.372	205.73	3.040	.237	108.79
3095	107.50 - 108.00	49.00 - 49.50	3.430	.489	152.28	2.746	.503	113.86
3096	107.50 - 108.00	49.50 - 50.00	3.430	.489	144.94	2.746	.503	145.93
3097	108.00 - 108.50	30.00 - 30.50	3.222	.666	103.66	3.516	.224	129.66
3098	108.00 - 108.50	30.50 - 31.00	3.430	.489	94.40	3.416	.163	140.83
3099	108.00 - 108.50	31.00 - 31.50	3.430	.489	80.58	3.364	.147	148.92
3100	108.00 - 108.50	31.50 - 32.00	4.148	.242	135.92	3.402	.113	156.55
3101	108.00 - 108.50	32.00 - 32.50	4.214	.202	116.60	3.193	.185	137.04
3102	108.00 - 108.50	32.50 - 33.00	4.243	.180	51.30	3.405	.116	154.85
3103	108.00 - 108.50	33.00 - 33.50	4.294	.200	81.93	3.309	.143	137.91
3104	108.00 - 108.50	33.50 - 34.00	4.334	.222	80.59	3.369	.131	128.06
3105	108.00 - 108.50	34.00 - 34.50	4.336	.228	73.42	3.655	.197	123.47
3106	108.00 - 108.50	34.50 - 35.00	4.339	.223	81.85	3.787	.137	110.34
3107	108.00 - 108.50	35.00 - 35.50	4.343	.219	98.96	3.805	.133	109.71
3108	108.00 - 108.50	35.50 - 36.00	4.368	.215	117.85	3.813	.129	96.79
3109	108.00 - 108.50	36.00 - 36.50	4.376	.212	135.96	3.813	.129	77.65
3110	108.00 - 108.50	36.50 - 37.00	4.379	.207	148.59	3.942	.124	72.76
3111	108.00 - 108.50	37.00 - 37.50	4.082	.173	118.26	4.014	.152	72.31
3112	108.00 - 108.50	37.50 - 38.00	3.992	.196	83.71	4.044	.170	39.90
3113	108.00 - 108.50	38.00 - 38.50	3.947	.204	58.29	4.039	.166	70.40
3114	108.00 - 108.50	38.50 - 39.00	3.780	.135	70.77	4.036	.164	77.49
3115	108.00 - 108.50	39.00 - 39.50	3.663	.221	87.48	4.036	.161	73.54

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3116	108.00 - 108.50	39.50 - 40.00	3.663	.221	103.23	3.944	.155	75.57
3117	108.00 - 108.50	40.00 - 40.50	3.697	.250	109.78	3.902	.292	65.17
3118	108.00 - 108.50	40.50 - 41.00	3.755	.297	109.78	3.931	.305	87.92
3119	108.00 - 108.50	41.00 - 41.50	3.744	.279	108.83	3.952	.316	105.47
3120	108.00 - 108.50	41.50 - 42.00	3.968	.101	130.76	3.955	.317	99.88
3121	108.00 - 108.50	42.00 - 42.50	4.011	.555	124.85	4.174	.081	139.85
3122	108.00 - 108.50	42.50 - 43.00	4.032	.558	113.47	4.095	.082	122.03
3123	108.00 - 108.50	43.00 - 43.50	4.023	.555	92.79	4.045	.092	91.43
3124	108.00 - 108.50	43.50 - 44.00	4.277	.353	54.57	4.033	.104	88.69
3125	108.00 - 108.50	44.00 - 44.50	4.277	.353	118.15	4.033	.104	109.85
3126	108.00 - 108.50	44.50 - 45.00	4.268	.355	128.97	4.023	.102	121.96
3127	108.00 - 108.50	45.00 - 45.50	4.300	.349	135.44	4.017	.196	120.26
3128	108.00 - 108.50	45.50 - 46.00	4.283	.350	143.87	3.982	.171	128.13
3129	108.00 - 108.50	46.00 - 46.50	4.274	.352	153.71	3.943	.146	138.66
3130	108.00 - 108.50	46.50 - 47.00	4.253	.356	165.54	3.907	.121	147.69
3131	108.00 - 108.50	47.00 - 47.50	4.242	.360	180.63	3.899	.119	153.56
3132	108.00 - 108.50	47.50 - 48.00	4.055	.264	180.17	3.559	.139	131.22
3133	108.00 - 108.50	48.00 - 48.50	3.983	.310	192.98	3.326	.150	125.43
3134	108.00 - 108.50	48.50 - 49.00	3.958	.339	205.65	3.166	.211	137.81
3135	108.00 - 108.50	49.00 - 49.50	3.516	.444	175.40	2.746	.503	125.12
3136	108.00 - 108.50	49.50 - 50.00	3.516	.444	173.53	2.746	.503	154.88
3137	108.50 - 109.00	30.00 - 30.50	3.222	.666	86.92	3.572	.255	160.52
3138	108.50 - 109.00	30.50 - 31.00	3.430	.489	65.76	3.288	.217	155.96
3139	108.50 - 109.00	31.00 - 31.50	3.430	.489	44.39	3.171	.243	155.48
3140	108.50 - 109.00	31.50 - 32.00	4.148	.242	113.90	3.207	.184	150.37
3141	108.50 - 109.00	32.00 - 32.50	4.214	.202	123.09	3.003	.088	116.80
3142	108.50 - 109.00	32.50 - 33.00	4.243	.180	93.35	3.257	.175	130.57
3143	108.50 - 109.00	33.00 - 33.50	4.294	.200	41.41	3.257	.175	125.29
3144	108.50 - 109.00	33.50 - 34.00	4.345	.215	94.97	3.369	.131	127.50
3145	108.50 - 109.00	34.00 - 34.50	4.362	.221	101.98	3.655	.197	120.16
3146	108.50 - 109.00	34.50 - 35.00	4.365	.216	107.39	3.787	.137	55.33
3147	108.50 - 109.00	35.00 - 35.50	4.369	.211	117.25	3.810	.133	116.93
3148	108.50 - 109.00	35.50 - 36.00	4.394	.204	128.94	3.818	.130	113.70
3149	108.50 - 109.00	36.00 - 36.50	4.399	.205	145.10	3.818	.130	99.60
3150	108.50 - 109.00	36.50 - 37.00	4.402	.200	159.80	3.951	.125	98.06

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
3151	108.50 - 109.00	37.00 - 37.50	4.128	.152	138.84	3.991	.134	91.69
3152	108.50 - 109.00	37.50 - 38.00	4.075	.152	119.94	4.024	.153	81.68
3153	108.50 - 109.00	38.00 - 38.50	4.066	.152	108.76	4.018	.149	88.84
3154	108.50 - 109.00	38.50 - 39.00	3.923	.109	106.56	4.021	.151	89.72
3155	108.50 - 109.00	39.00 - 39.50	3.880	.181	117.13	4.032	.155	84.02
3156	108.50 - 109.00	39.50 - 40.00	3.801	.322	114.65	3.938	.153	69.67
3157	108.50 - 109.00	40.00 - 40.50	3.848	.357	117.42	3.909	.296	28.57
3158	108.50 - 109.00	40.50 - 41.00	3.882	.385	114.09	3.941	.312	76.88
3159	108.50 - 109.00	41.00 - 41.50	3.877	.375	101.34	3.962	.322	102.89
3160	108.50 - 109.00	41.50 - 42.00	4.154	.126	107.58	3.962	.320	108.24
3161	108.50 - 109.00	42.00 - 42.50	4.063	.569	105.71	3.979	.314	106.41
3162	108.50 - 109.00	42.50 - 43.00	4.085	.576	95.40	3.984	.316	93.69
3163	108.50 - 109.00	43.00 - 43.50	4.081	.574	72.25	3.970	.306	41.61
3164	108.50 - 109.00	43.50 - 44.00	4.310	.348	96.09	3.974	.309	85.37
3165	108.50 - 109.00	44.00 - 44.50	4.310	.348	111.47	3.969	.305	90.97
3166	108.50 - 109.00	44.50 - 45.00	4.308	.349	116.72	3.953	.294	90.51
3167	108.50 - 109.00	45.00 - 45.50	4.541	.201	141.12	4.025	.202	102.14
3168	108.50 - 109.00	45.50 - 46.00	4.529	.207	144.46	3.992	.179	111.26
3169	108.50 - 109.00	46.00 - 46.50	4.518	.213	149.69	3.954	.154	123.75
3170	108.50 - 109.00	46.50 - 47.00	4.505	.223	158.17	3.919	.131	136.71
3171	108.50 - 109.00	47.00 - 47.50	4.497	.228	170.96	3.912	.128	151.46
3172	108.50 - 109.00	47.50 - 48.00	4.353	.187	172.93	3.599	.141	146.99
3173	108.50 - 109.00	48.00 - 48.50	4.316	.223	190.86	3.382	.116	147.05
3174	108.50 - 109.00	48.50 - 49.00	4.306	.238	212.42	3.207	.184	155.99
3175	108.50 - 109.00	49.00 - 49.50	4.140	.241	227.08	2.896	.375	155.45
3176	108.50 - 109.00	49.50 - 50.00	3.430	.489	194.17	2.746	.503	166.59
3177	109.00 - 109.50	30.00 - 30.50	3.222	.666	80.45	3.725	.184	170.49
3178	109.00 - 109.50	30.50 - 31.00	3.430	.489	51.44	3.522	.167	171.90
3179	109.00 - 109.50	31.00 - 31.50	3.430	.489	14.50	3.329	.176	166.79
3180	109.00 - 109.50	31.50 - 32.00	4.148	.242	97.24	3.207	.184	139.42
3181	109.00 - 109.50	32.00 - 32.50	4.214	.202	133.86	3.003	.088	95.23
3182	109.00 - 109.50	32.50 - 33.00	4.239	.186	118.68	3.214	.194	99.44
3183	109.00 - 109.50	33.00 - 33.50	4.289	.206	98.77	3.214	.194	102.35
3184	109.00 - 109.50	33.50 - 34.00	4.356	.208	113.84	3.328	.153	116.77
3185	109.00 - 109.50	34.00 - 34.50	4.375	.211	118.54	3.642	.199	130.49

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3186	109.00 - 109.50	34.50 - 35.00	4.379	.206	122.65	3.777	.144	121.77
3187	109.00 - 109.50	35.00 - 35.50	4.385	.197	121.62	3.808	.137	134.56
3188	109.00 - 109.50	35.50 - 36.00	4.409	.192	109.55	3.839	.136	133.31
3189	109.00 - 109.50	36.00 - 36.50	4.520	.253	149.86	3.910	.132	129.07
3190	109.00 - 109.50	36.50 - 37.00	4.522	.249	172.76	4.026	.139	125.18
3191	109.00 - 109.50	37.00 - 37.50	4.354	.243	167.75	4.060	.146	116.91
3192	109.00 - 109.50	37.50 - 38.00	4.319	.251	159.72	4.088	.162	108.46
3193	109.00 - 109.50	38.00 - 38.50	4.340	.232	156.43	4.085	.157	98.57
3194	109.00 - 109.50	38.50 - 39.00	4.303	.206	154.68	4.091	.160	92.52
3195	109.00 - 109.50	39.00 - 39.50	4.279	.143	153.00	4.102	.164	61.34
3196	109.00 - 109.50	39.50 - 40.00	4.307	.125	153.97	4.029	.144	70.25
3197	109.00 - 109.50	40.00 - 40.50	4.330	.118	151.14	4.048	.207	40.94
3198	109.00 - 109.50	40.50 - 41.00	4.344	.123	145.63	4.072	.216	85.89
3199	109.00 - 109.50	41.00 - 41.50	4.341	.114	128.32	4.066	.212	107.35
3200	109.00 - 109.50	41.50 - 42.00	4.169	.170	48.97	3.964	.321	99.86
3201	109.00 - 109.50	42.00 - 42.50	4.349	.259	117.75	3.974	.310	93.84
3202	109.00 - 109.50	42.50 - 43.00	4.351	.274	104.95	3.982	.314	88.36
3203	109.00 - 109.50	43.00 - 43.50	4.346	.272	43.55	3.971	.307	75.93
3204	109.00 - 109.50	43.50 - 44.00	4.435	.238	103.20	3.973	.308	81.33
3205	109.00 - 109.50	44.00 - 44.50	4.567	.182	121.93	3.969	.306	77.33
3206	109.00 - 109.50	44.50 - 45.00	4.561	.185	120.21	3.957	.295	68.51
3207	109.00 - 109.50	45.00 - 45.50	4.547	.198	120.44	4.079	.168	83.73
3208	109.00 - 109.50	45.50 - 46.00	4.536	.203	123.57	4.048	.146	96.97
3209	109.00 - 109.50	46.00 - 46.50	4.526	.208	127.73	4.014	.121	112.33
3210	109.00 - 109.50	46.50 - 47.00	4.524	.206	136.82	3.982	.100	128.46
3211	109.00 - 109.50	47.00 - 47.50	4.517	.211	150.18	3.979	.101	148.02
3212	109.00 - 109.50	47.50 - 48.00	4.302	.122	143.60	3.643	.140	147.42
3213	109.00 - 109.50	48.00 - 48.50	4.269	.149	162.58	3.411	.066	152.74
3214	109.00 - 109.50	48.50 - 49.00	4.259	.163	185.59	3.256	.111	164.52
3215	109.00 - 109.50	49.00 - 49.50	4.113	.222	211.78	2.972	.280	172.32
3216	109.00 - 109.50	49.50 - 50.00	3.208	.187	182.00	2.821	.411	185.86
3217	109.50 - 110.00	30.00 - 30.50	3.222	.666	87.28	3.980	.239	181.92
3218	109.50 - 110.00	30.50 - 31.00	3.430	.489	66.07	3.722	.167	178.53
3219	109.50 - 110.00	31.00 - 31.50	3.430	.489	44.61	3.552	.198	178.16
3220	109.50 - 110.00	31.50 - 32.00	4.137	.260	119.60	3.164	.211	119.96

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3221	109.50 - 110.00	32.00 - 32.50	4.143	.250	144.13	2.939	.065	64.93
3222	109.50 - 110.00	32.50 - 33.00	4.169	.236	139.35	2.854	.085	40.68
3223	109.50 - 110.00	33.00 - 33.50	4.188	.218	125.63	2.854	.085	53.44
3224	109.50 - 110.00	33.50 - 34.00	4.333	.223	120.53	3.273	.155	95.51
3225	109.50 - 110.00	34.00 - 34.50	4.347	.231	100.36	3.627	.192	128.49
3226	109.50 - 110.00	34.50 - 35.00	4.358	.226	120.29	3.766	.144	146.75
3227	109.50 - 110.00	35.00 - 35.50	4.365	.216	114.45	3.799	.134	152.10
3228	109.50 - 110.00	35.50 - 36.00	4.411	.198	47.37	3.831	.132	150.32
3229	109.50 - 110.00	36.00 - 36.50	4.511	.258	134.85	3.903	.129	147.66
3230	109.50 - 110.00	36.50 - 37.00	4.514	.254	166.64	4.009	.129	140.51
3231	109.50 - 110.00	37.00 - 37.50	4.342	.250	161.37	4.041	.134	129.20
3232	109.50 - 110.00	37.50 - 38.00	4.306	.258	156.52	4.070	.150	114.03
3233	109.50 - 110.00	38.00 - 38.50	4.363	.209	156.21	4.067	.145	65.03
3234	109.50 - 110.00	38.50 - 39.00	4.332	.174	150.16	4.074	.148	81.83
3235	109.50 - 110.00	39.00 - 39.50	4.352	.157	148.32	4.090	.155	60.87
3236	109.50 - 110.00	39.50 - 40.00	4.375	.146	143.76	4.014	.133	53.98
3237	109.50 - 110.00	40.00 - 40.50	4.389	.138	136.28	4.031	.197	52.22
3238	109.50 - 110.00	40.50 - 41.00	4.402	.141	130.22	4.056	.207	86.94
3239	109.50 - 110.00	41.00 - 41.50	4.380	.138	121.77	4.050	.203	99.39
3240	109.50 - 110.00	41.50 - 42.00	4.155	.160	86.94	3.946	.311	84.42
3241	109.50 - 110.00	42.00 - 42.50	4.405	.227	115.14	4.043	.216	75.79
3242	109.50 - 110.00	42.50 - 43.00	4.408	.238	105.83	4.058	.226	81.87
3243	109.50 - 110.00	43.00 - 43.50	4.404	.237	87.04	4.048	.219	80.16
3244	109.50 - 110.00	43.50 - 44.00	4.483	.209	98.41	4.052	.221	75.52
3245	109.50 - 110.00	44.00 - 44.50	4.596	.177	103.53	4.049	.219	66.04
3246	109.50 - 110.00	44.50 - 45.00	4.567	.182	95.62	4.035	.208	41.71
3247	109.50 - 110.00	45.00 - 45.50	4.556	.195	98.55	4.081	.172	54.31
3248	109.50 - 110.00	45.50 - 46.00	4.546	.199	103.09	4.059	.156	77.20
3249	109.50 - 110.00	46.00 - 46.50	4.536	.203	105.66	4.027	.131	96.35
3250	109.50 - 110.00	46.50 - 47.00	4.535	.199	114.68	4.006	.119	115.34
3251	109.50 - 110.00	47.00 - 47.50	4.529	.203	129.25	4.003	.119	136.38
3252	109.50 - 110.00	47.50 - 48.00	4.319	.120	126.17	3.706	.176	139.93
3253	109.50 - 110.00	48.00 - 48.50	4.281	.141	146.00	3.518	.107	150.21
3254	109.50 - 110.00	48.50 - 49.00	4.272	.155	170.09	3.416	.089	165.45
3255	109.50 - 110.00	49.00 - 49.50	4.136	.208	195.39	3.271	.152	184.34

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
3256	109.50 - 110.00	49.50 - 50.00	3.259	.117	164.32	3.190	.210	206.58
3257	110.00 - 110.50	30.00 - 30.50	3.222	.666	104.79	4.119	.241	162.30
3258	110.00 - 110.50	30.50 - 31.00	3.430	.489	96.12	3.941	.211	160.85
3259	110.00 - 110.50	31.00 - 31.50	3.430	.489	83.13	3.850	.228	166.07
3260	110.00 - 110.50	31.50 - 32.00	3.594	.383	105.31	3.604	.252	134.66
3261	110.00 - 110.50	32.00 - 32.50	3.615	.358	119.78	3.639	.245	97.56
3262	110.00 - 110.50	32.50 - 33.00	3.702	.319	125.74	3.561	.256	28.67
3263	110.00 - 110.50	33.00 - 33.50	3.762	.270	112.52	3.273	.155	56.07
3264	110.00 - 110.50	33.50 - 34.00	4.241	.239	108.22	3.337	.132	79.38
3265	110.00 - 110.50	34.00 - 34.50	4.232	.248	36.67	3.611	.177	92.35
3266	110.00 - 110.50	34.50 - 35.00	4.260	.233	103.84	3.718	.143	135.30
3267	110.00 - 110.50	35.00 - 35.50	4.281	.214	115.46	3.775	.131	162.93
3268	110.00 - 110.50	35.50 - 36.00	4.343	.196	101.19	3.804	.125	164.96
3269	110.00 - 110.50	36.00 - 36.50	4.461	.260	129.28	3.880	.126	161.17
3270	110.00 - 110.50	36.50 - 37.00	4.461	.260	146.99	3.981	.118	148.39
3271	110.00 - 110.50	37.00 - 37.50	4.270	.244	137.67	4.019	.123	133.23
3272	110.00 - 110.50	37.50 - 38.00	4.291	.225	139.64	4.049	.136	116.55
3273	110.00 - 110.50	38.00 - 38.50	4.347	.178	138.14	4.059	.140	96.05
3274	110.00 - 110.50	38.50 - 39.00	4.358	.170	135.60	4.067	.143	72.55
3275	110.00 - 110.50	39.00 - 39.50	4.375	.156	132.77	4.083	.150	27.63
3276	110.00 - 110.50	39.50 - 40.00	4.418	.142	128.15	4.008	.128	24.10
3277	110.00 - 110.50	40.00 - 40.50	4.423	.135	115.53	4.024	.192	61.86
3278	110.00 - 110.50	40.50 - 41.00	4.428	.139	103.46	4.038	.198	83.91
3279	110.00 - 110.50	41.00 - 41.50	4.401	.137	106.93	4.020	.189	87.75
3280	110.00 - 110.50	41.50 - 42.00	4.184	.165	85.36	3.912	.295	64.91
3281	110.00 - 110.50	42.00 - 42.50	4.422	.218	102.33	4.030	.206	36.51
3282	110.00 - 110.50	42.50 - 43.00	4.431	.226	96.02	4.048	.217	61.66
3283	110.00 - 110.50	43.00 - 43.50	4.426	.225	86.51	4.039	.212	62.30
3284	110.00 - 110.50	43.50 - 44.00	4.504	.195	77.72	4.045	.217	52.22
3285	110.00 - 110.50	44.00 - 44.50	4.614	.167	78.51	4.044	.216	45.85
3286	110.00 - 110.50	44.50 - 45.00	4.587	.170	65.22	4.036	.213	29.73
3287	110.00 - 110.50	45.00 - 45.50	4.564	.194	75.24	4.083	.174	52.06
3288	110.00 - 110.50	45.50 - 46.00	4.564	.185	83.89	4.065	.161	48.44
3289	110.00 - 110.50	46.00 - 46.50	4.555	.189	82.60	4.033	.137	81.67
3290	110.00 - 110.50	46.50 - 47.00	4.553	.186	93.09	4.014	.125	101.99

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3291	110.00 - 110.50	47.00 - 47.50	4.548	.190	109.25	4.011	.125	125.06
3292	110.00 - 110.50	47.50 - 48.00	4.346	.117	110.53	3.725	.186	129.22
3293	110.00 - 110.50	48.00 - 48.50	4.312	.135	132.25	3.551	.114	139.22
3294	110.00 - 110.50	48.50 - 49.00	4.304	.147	156.94	3.460	.085	152.65
3295	110.00 - 110.50	49.00 - 49.50	4.191	.192	182.09	3.338	.116	168.21
3296	110.00 - 110.50	49.50 - 50.00	3.581	.181	173.22	3.282	.133	188.54
3297	110.50 - 111.00	30.00 - 30.50	3.222	.666	128.35	4.231	.204	140.74
3298	110.50 - 111.00	30.50 - 31.00	3.430	.489	129.26	4.080	.215	137.37
3299	110.50 - 111.00	31.00 - 31.50	3.430	.489	119.35	4.024	.207	144.24
3300	110.50 - 111.00	31.50 - 32.00	3.594	.383	136.72	3.836	.304	129.24
3301	110.50 - 111.00	32.00 - 32.50	3.615	.358	140.81	3.836	.304	116.94
3302	110.50 - 111.00	32.50 - 33.00	3.702	.319	141.07	3.738	.256	82.38
3303	110.50 - 111.00	33.00 - 33.50	3.762	.270	123.82	3.564	.136	35.32
3304	110.50 - 111.00	33.50 - 34.00	3.934	.256	104.16	4.021	.184	122.78
3305	110.50 - 111.00	34.00 - 34.50	3.828	.172	66.55	3.667	.168	37.20
3306	110.50 - 111.00	34.50 - 35.00	3.931	.149	87.17	3.352	.119	86.85
3307	110.50 - 111.00	35.00 - 35.50	3.968	.122	88.34	3.370	.136	132.22
3308	110.50 - 111.00	35.50 - 36.00	4.050	.147	81.82	3.485	.110	156.69
3309	110.50 - 111.00	36.00 - 36.50	4.285	.233	83.71	3.573	.141	147.93
3310	110.50 - 111.00	36.50 - 37.00	4.285	.233	104.78	3.787	.115	139.21
3311	110.50 - 111.00	37.00 - 37.50	4.280	.241	120.50	3.857	.133	119.95
3312	110.50 - 111.00	37.50 - 38.00	4.302	.221	122.84	3.909	.149	103.21
3313	110.50 - 111.00	38.00 - 38.50	4.355	.175	118.87	3.928	.153	87.01
3314	110.50 - 111.00	38.50 - 39.00	4.364	.171	114.31	3.940	.158	65.45
3315	110.50 - 111.00	39.00 - 39.50	4.382	.154	113.91	3.980	.175	38.58
3316	110.50 - 111.00	39.50 - 40.00	4.424	.140	107.94	3.991	.179	38.50
3317	110.50 - 111.00	40.00 - 40.50	4.414	.139	87.76	4.029	.195	50.94
3318	110.50 - 111.00	40.50 - 41.00	4.418	.142	56.01	4.044	.200	73.74
3319	110.50 - 111.00	41.00 - 41.50	4.398	.140	86.90	4.026	.190	77.58
3320	110.50 - 111.00	41.50 - 42.00	4.182	.165	65.13	3.920	.297	36.58
3321	110.50 - 111.00	42.00 - 42.50	4.419	.220	79.96	4.037	.211	56.69
3322	110.50 - 111.00	42.50 - 43.00	4.428	.227	72.48	4.054	.222	33.89
3323	110.50 - 111.00	43.00 - 43.50	4.424	.226	67.57	4.047	.217	35.10
3324	110.50 - 111.00	43.50 - 44.00	4.502	.196	40.58	4.052	.222	56.31
3325	110.50 - 111.00	44.00 - 44.50	4.613	.168	47.10	4.052	.221	38.08

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3326	110.50 - 111.00	44.50 - 45.00	4.593	.171	30.41	4.036	.213	22.57
3327	110.50 - 111.00	45.00 - 45.50	4.567	.191	48.73	4.149	.301	34.12
3328	110.50 - 111.00	45.50 - 46.00	4.584	.170	65.92	4.143	.297	59.58
3329	110.50 - 111.00	46.00 - 46.50	4.575	.173	53.32	4.123	.282	67.90
3330	110.50 - 111.00	46.50 - 47.00	4.573	.172	72.41	4.115	.276	91.18
3331	110.50 - 111.00	47.00 - 47.50	4.567	.175	87.24	4.103	.269	111.27
3332	110.50 - 111.00	47.50 - 48.00	4.375	.114	95.81	4.160	.120	146.24
3333	110.50 - 111.00	48.00 - 48.50	4.344	.126	119.97	4.066	.141	152.98
3334	110.50 - 111.00	48.50 - 49.00	4.337	.137	144.16	4.028	.144	164.81
3335	110.50 - 111.00	49.00 - 49.50	4.247	.168	167.34	3.988	.155	180.95
3336	110.50 - 111.00	49.50 - 50.00	3.792	.161	164.94	3.972	.159	201.77
3337	111.00 - 111.50	30.00 - 30.50	3.067	.849	137.04	4.387	.313	112.92
3338	111.00 - 111.50	30.50 - 31.00	3.378	.552	158.65	4.325	.297	114.30
3339	111.00 - 111.50	31.00 - 31.50	3.378	.552	150.52	4.307	.287	120.74
3340	111.00 - 111.50	31.50 - 32.00	3.565	.420	166.96	4.257	.283	125.01
3341	111.00 - 111.50	32.00 - 32.50	3.594	.383	164.43	4.252	.280	132.49
3342	111.00 - 111.50	32.50 - 33.00	3.686	.338	158.24	4.216	.256	137.79
3343	111.00 - 111.50	33.00 - 33.50	3.750	.283	138.99	4.071	.264	121.22
3344	111.00 - 111.50	33.50 - 34.00	3.962	.234	130.41	4.425	.339	170.18
3345	111.00 - 111.50	34.00 - 34.50	3.862	.157	97.18	3.784	.279	105.23
3346	111.00 - 111.50	34.50 - 35.00	3.963	.132	86.84	3.953	.159	157.61
3347	111.00 - 111.50	35.00 - 35.50	3.995	.113	67.61	3.956	.150	175.61
3348	111.00 - 111.50	35.50 - 36.00	4.027	.125	63.32	3.959	.146	169.41
3349	111.00 - 111.50	36.00 - 36.50	4.265	.239	33.06	4.007	.155	157.49
3350	111.00 - 111.50	36.50 - 37.00	4.265	.239	78.56	4.052	.148	137.72
3351	111.00 - 111.50	37.00 - 37.50	4.260	.247	100.04	4.083	.157	117.62
3352	111.00 - 111.50	37.50 - 38.00	4.287	.217	101.82	4.105	.172	96.89
3353	111.00 - 111.50	38.00 - 38.50	4.343	.170	93.44	4.113	.177	89.27
3354	111.00 - 111.50	38.50 - 39.00	4.351	.167	85.24	4.120	.179	73.75
3355	111.00 - 111.50	39.00 - 39.50	4.370	.150	91.47	4.136	.190	38.44
3356	111.00 - 111.50	39.50 - 40.00	4.415	.134	87.88	4.143	.192	43.07
3357	111.00 - 111.50	40.00 - 40.50	4.401	.136	49.79	3.918	.297	41.72
3358	111.00 - 111.50	40.50 - 41.00	4.406	.139	57.51	3.937	.307	38.00
3359	111.00 - 111.50	41.00 - 41.50	4.403	.133	70.71	3.924	.300	59.21
3360	111.00 - 111.50	41.50 - 42.00	4.187	.165	34.21	4.081	.091	63.88

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
3361	111.00 - 111.50	42.00 - 42.50	4.422	.218	49.21	4.043	.214	42.92
3362	111.00 - 111.50	42.50 - 43.00	4.431	.226	37.49	4.060	.225	27.64
3363	111.00 - 111.50	43.00 - 43.50	4.425	.225	37.93	4.053	.220	25.68
3364	111.00 - 111.50	43.50 - 44.00	4.504	.195	44.30	4.059	.225	46.99
3365	111.00 - 111.50	44.00 - 44.50	4.614	.167	52.60	4.058	.225	44.06
3366	111.00 - 111.50	44.50 - 45.00	4.595	.169	27.15	4.044	.219	16.79
3367	111.00 - 111.50	45.00 - 45.50	4.577	.179	34.41	4.175	.321	35.64
3368	111.00 - 111.50	45.50 - 46.00	4.584	.170	47.78	4.171	.317	45.06
3369	111.00 - 111.50	46.00 - 46.50	4.575	.173	23.19	4.153	.303	37.57
3370	111.00 - 111.50	46.50 - 47.00	4.573	.172	56.13	4.145	.298	81.38
3371	111.00 - 111.50	47.00 - 47.50	4.566	.177	55.21	4.307	.240	119.25
3372	111.00 - 111.50	47.50 - 48.00	4.375	.114	82.24	4.305	.133	139.97
3373	111.00 - 111.50	48.00 - 48.50	4.344	.126	109.26	4.252	.161	145.56
3374	111.00 - 111.50	48.50 - 49.00	4.337	.137	132.91	4.232	.169	152.70
3375	111.00 - 111.50	49.00 - 49.50	4.247	.168	151.55	4.211	.182	160.91
3376	111.00 - 111.50	49.50 - 50.00	3.792	.161	144.43	4.203	.189	170.93
3377	111.50 - 112.00	30.00 - 30.50	3.386	.546	210.14	4.720	.335	110.96
3378	111.50 - 112.00	30.50 - 31.00	3.386	.546	194.09	4.698	.323	113.10
3379	111.50 - 112.00	31.00 - 31.50	3.386	.546	185.96	4.689	.321	118.99
3380	111.50 - 112.00	31.50 - 32.00	3.571	.416	197.20	4.674	.314	127.23
3381	111.50 - 112.00	32.00 - 32.50	3.598	.379	187.26	4.662	.310	139.11
3382	111.50 - 112.00	32.50 - 33.00	3.690	.335	175.56	4.548	.387	142.86
3383	111.50 - 112.00	33.00 - 33.50	3.753	.282	154.81	4.486	.362	156.80
3384	111.50 - 112.00	33.50 - 34.00	4.360	.407	195.56	4.449	.348	172.07
3385	111.50 - 112.00	34.00 - 34.50	4.335	.374	152.27	3.841	.302	138.15
3386	111.50 - 112.00	34.50 - 35.00	4.381	.334	107.52	3.991	.171	167.22
3387	111.50 - 112.00	35.00 - 35.50	4.239	.203	36.22	3.976	.158	166.06
3388	111.50 - 112.00	35.50 - 36.00	4.261	.191	48.80	3.970	.147	153.21
3389	111.50 - 112.00	36.00 - 36.50	4.317	.199	68.51	4.017	.155	139.87
3390	111.50 - 112.00	36.50 - 37.00	4.317	.199	44.68	4.062	.150	122.43
3391	111.50 - 112.00	37.00 - 37.50	4.313	.205	87.96	4.092	.160	101.22
3392	111.50 - 112.00	37.50 - 38.00	4.335	.184	83.55	4.113	.175	54.04
3393	111.50 - 112.00	38.00 - 38.50	4.380	.151	70.72	4.121	.180	68.86
3394	111.50 - 112.00	38.50 - 39.00	4.378	.151	51.36	4.123	.181	58.82
3395	111.50 - 112.00	39.00 - 39.50	4.370	.150	70.26	4.133	.187	43.46

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3396	111.50 - 112.00	39.50 - 40.00	4.415	.134	73.40	4.140	.189	56.50
3397	111.50 - 112.00	40.00 - 40.50	4.414	.134	36.48	3.912	.292	64.16
3398	111.50 - 112.00	40.50 - 41.00	4.420	.137	25.67	3.938	.307	60.74
3399	111.50 - 112.00	41.00 - 41.50	4.414	.134	57.82	3.927	.301	32.55
3400	111.50 - 112.00	41.50 - 42.00	4.207	.167	46.79	4.155	.107	39.79
3401	111.50 - 112.00	42.00 - 42.50	4.433	.211	39.77	4.078	.242	63.33
3402	111.50 - 112.00	42.50 - 43.00	4.443	.216	37.66	4.094	.253	36.96
3403	111.50 - 112.00	43.00 - 43.50	4.437	.215	67.14	4.088	.248	36.67
3404	111.50 - 112.00	43.50 - 44.00	4.514	.185	76.13	4.092	.253	60.22
3405	111.50 - 112.00	44.00 - 44.50	4.622	.159	72.77	4.092	.252	49.35
3406	111.50 - 112.00	44.50 - 45.00	4.603	.160	41.94	4.079	.247	21.19
3407	111.50 - 112.00	45.00 - 45.50	4.596	.157	40.30	4.176	.322	26.89
3408	111.50 - 112.00	45.50 - 46.00	4.602	.152	44.41	4.171	.318	38.10
3409	111.50 - 112.00	46.00 - 46.50	4.594	.155	40.86	4.153	.304	42.42
3410	111.50 - 112.00	46.50 - 47.00	4.590	.157	39.85	4.151	.302	74.19
3411	111.50 - 112.00	47.00 - 47.50	4.584	.162	44.47	4.309	.240	106.27
3412	111.50 - 112.00	47.50 - 48.00	4.376	.112	74.50	4.305	.133	121.72
3413	111.50 - 112.00	48.00 - 48.50	4.346	.123	101.35	4.252	.161	125.75
3414	111.50 - 112.00	48.50 - 49.00	4.339	.133	121.81	4.232	.169	133.34
3415	111.50 - 112.00	49.00 - 49.50	4.251	.162	130.88	4.211	.182	141.61
3416	111.50 - 112.00	49.50 - 50.00	3.806	.143	122.92	4.203	.189	151.18
3417	112.00 - 112.50	30.00 - 30.50	3.633	.743	302.85	4.772	.286	86.30
3418	112.00 - 112.50	30.50 - 31.00	3.911	.746	302.02	4.711	.328	85.25
3419	112.00 - 112.50	31.00 - 31.50	3.911	.746	269.06	4.703	.325	94.33
3420	112.00 - 112.50	31.50 - 32.00	4.008	.652	251.98	4.688	.319	102.20
3421	112.00 - 112.50	32.00 - 32.50	4.029	.623	230.38	4.677	.315	117.17
3422	112.00 - 112.50	32.50 - 33.00	4.087	.573	217.34	4.564	.393	125.46
3423	112.00 - 112.50	33.00 - 33.50	4.172	.482	209.03	4.507	.369	143.53
3424	112.00 - 112.50	33.50 - 34.00	4.481	.362	210.56	4.464	.353	160.99
3425	112.00 - 112.50	34.00 - 34.50	4.459	.334	160.26	3.893	.323	125.63
3426	112.00 - 112.50	34.50 - 35.00	4.493	.300	67.14	4.024	.182	158.77
3427	112.00 - 112.50	35.00 - 35.50	4.339	.189	90.39	4.016	.176	155.60
3428	112.00 - 112.50	35.50 - 36.00	4.358	.175	89.66	4.006	.167	138.40
3429	112.00 - 112.50	36.00 - 36.50	4.346	.180	42.63	4.050	.170	123.15
3430	112.00 - 112.50	36.50 - 37.00	4.346	.180	78.74	4.091	.169	107.35

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3431	112.00 - 112.50	37.00 - 37.50	4.343	.185	75.79	4.118	.179	91.11
3432	112.00 - 112.50	37.50 - 38.00	4.362	.168	50.63	4.128	.185	52.24
3433	112.00 - 112.50	38.00 - 38.50	4.402	.143	53.65	4.135	.190	36.27
3434	112.00 - 112.50	38.50 - 39.00	4.401	.139	19.42	4.138	.191	27.19
3435	112.00 - 112.50	39.00 - 39.50	4.370	.150	58.82	4.147	.197	37.32
3436	112.00 - 112.50	39.50 - 40.00	4.415	.134	46.72	4.153	.199	80.02
3437	112.00 - 112.50	40.00 - 40.50	4.414	.134	47.48	3.919	.294	75.83
3438	112.00 - 112.50	40.50 - 41.00	4.420	.137	35.85	3.905	.291	42.30
3439	112.00 - 112.50	41.00 - 41.50	4.414	.134	35.90	3.891	.285	46.35
3440	112.00 - 112.50	41.50 - 42.00	4.207	.167	27.13	4.121	.141	58.49
3441	112.00 - 112.50	42.00 - 42.50	4.453	.203	32.67	4.066	.238	76.33
3442	112.00 - 112.50	42.50 - 43.00	4.464	.203	67.21	4.084	.248	67.82
3443	112.00 - 112.50	43.00 - 43.50	4.459	.203	85.77	4.087	.251	65.81
3444	112.00 - 112.50	43.50 - 44.00	4.533	.171	95.66	4.092	.256	69.33
3445	112.00 - 112.50	44.00 - 44.50	4.636	.147	87.25	4.091	.255	56.98
3446	112.00 - 112.50	44.50 - 45.00	4.620	.144	42.93	4.078	.251	40.18
3447	112.00 - 112.50	45.00 - 45.50	4.595	.158	66.48	4.176	.322	39.91
3448	112.00 - 112.50	45.50 - 46.00	4.601	.154	64.96	4.172	.318	43.09
3449	112.00 - 112.50	46.00 - 46.50	4.593	.157	43.01	4.154	.304	61.93
3450	112.00 - 112.50	46.50 - 47.00	4.590	.157	17.21	4.152	.303	52.16
3451	112.00 - 112.50	47.00 - 47.50	4.584	.162	53.30	4.309	.240	89.87
3452	112.00 - 112.50	47.50 - 48.00	4.376	.112	72.49	4.305	.133	101.89
3453	112.00 - 112.50	48.00 - 48.50	4.346	.123	95.19	4.252	.161	104.65
3454	112.00 - 112.50	48.50 - 49.00	4.339	.133	109.71	4.232	.169	114.19
3455	112.00 - 112.50	49.00 - 49.50	4.251	.162	93.23	4.211	.182	122.88
3456	112.00 - 112.50	49.50 - 50.00	3.806	.143	100.05	4.203	.189	131.31
3457	112.50 - 113.00	30.00 - 30.50	3.863	.667	300.77	4.780	.287	42.63
3458	112.50 - 113.00	30.50 - 31.00	4.166	.640	291.85	4.720	.330	48.07
3459	112.50 - 113.00	31.00 - 31.50	4.166	.640	254.68	4.712	.328	70.96
3460	112.50 - 113.00	31.50 - 32.00	4.214	.586	230.20	4.697	.321	68.46
3461	112.50 - 113.00	32.00 - 32.50	4.229	.562	209.79	4.686	.317	95.46
3462	112.50 - 113.00	32.50 - 33.00	4.263	.528	200.93	4.575	.397	106.25
3463	112.50 - 113.00	33.00 - 33.50	4.307	.469	201.94	4.520	.373	128.50
3464	112.50 - 113.00	33.50 - 34.00	4.786	.370	223.79	4.533	.379	146.23
3465	112.50 - 113.00	34.00 - 34.50	4.791	.367	209.25	4.182	.317	78.77

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
3466	112.50 - 113.00	34.50 - 35.00	4.801	.353	179.09	4.240	.246	153.71
3467	112.50 - 113.00	35.00 - 35.50	4.701	.276	163.99	4.214	.242	151.65
3468	112.50 - 113.00	35.50 - 36.00	4.568	.242	133.69	4.170	.213	132.78
3469	112.50 - 113.00	36.00 - 36.50	4.354	.177	88.99	4.156	.202	111.69
3470	112.50 - 113.00	36.50 - 37.00	4.356	.178	83.02	4.178	.196	94.31
3471	112.50 - 113.00	37.00 - 37.50	4.343	.185	40.32	4.195	.198	80.88
3472	112.50 - 113.00	37.50 - 38.00	4.362	.168	60.32	4.200	.198	74.03
3473	112.50 - 113.00	38.00 - 38.50	4.423	.133	30.58	4.206	.201	71.55
3474	112.50 - 113.00	38.50 - 39.00	4.420	.132	49.89	4.208	.202	66.79
3475	112.50 - 113.00	39.00 - 39.50	4.388	.150	70.55	4.216	.207	78.02
3476	112.50 - 113.00	39.50 - 40.00	4.430	.134	81.55	4.208	.200	100.71
3477	112.50 - 113.00	40.00 - 40.50	4.430	.134	73.38	3.914	.292	88.44
3478	112.50 - 113.00	40.50 - 41.00	4.428	.138	37.04	3.893	.289	78.10
3479	112.50 - 113.00	41.00 - 41.50	4.422	.136	61.39	3.878	.285	75.50
3480	112.50 - 113.00	41.50 - 42.00	4.221	.167	28.80	4.102	.163	93.19
3481	112.50 - 113.00	42.00 - 42.50	4.459	.201	58.57	4.059	.236	90.66
3482	112.50 - 113.00	42.50 - 43.00	4.471	.198	81.97	4.078	.245	87.21
3483	112.50 - 113.00	43.00 - 43.50	4.466	.198	99.71	4.089	.252	82.71
3484	112.50 - 113.00	43.50 - 44.00	4.528	.173	108.85	4.093	.256	76.77
3485	112.50 - 113.00	44.00 - 44.50	4.632	.149	103.12	4.092	.256	62.79
3486	112.50 - 113.00	44.50 - 45.00	4.617	.145	80.94	4.079	.252	29.11
3487	112.50 - 113.00	45.00 - 45.50	4.613	.146	78.93	4.172	.319	34.90
3488	112.50 - 113.00	45.50 - 46.00	4.618	.142	75.89	4.167	.315	62.21
3489	112.50 - 113.00	46.00 - 46.50	4.611	.144	40.81	4.155	.305	49.55
3490	112.50 - 113.00	46.50 - 47.00	4.599	.149	37.52	4.152	.303	54.65
3491	112.50 - 113.00	47.00 - 47.50	4.591	.155	61.48	4.309	.240	61.89
3492	112.50 - 113.00	47.50 - 48.00	4.385	.111	69.75	4.305	.133	80.90
3493	112.50 - 113.00	48.00 - 48.50	4.357	.117	88.04	4.252	.161	79.37
3494	112.50 - 113.00	48.50 - 49.00	4.350	.126	99.93	4.232	.169	95.72
3495	112.50 - 113.00	49.00 - 49.50	4.269	.149	45.05	4.211	.182	104.61
3496	112.50 - 113.00	49.50 - 50.00	3.862	.125	91.73	4.203	.189	110.70
3497	113.00 - 113.50	31.00 - 31.50	4.677	.496	241.07	4.752	.341	45.18
3498	113.00 - 113.50	31.50 - 32.00	4.687	.484	213.19	4.740	.336	48.57
3499	113.00 - 113.50	32.00 - 32.50	4.691	.476	192.37	4.731	.332	77.46
3500	113.00 - 113.50	32.50 - 33.00	4.702	.465	183.52	4.625	.418	75.11

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3501	113.00 - 113.50	33.00 - 33.50	4.718	.441	188.54	4.578	.396	115.40
3502	113.00 - 113.50	33.50 - 34.00	4.825	.332	202.38	4.667	.258	142.27
3503	113.00 - 113.50	34.00 - 34.50	4.829	.330	207.76	4.420	.202	141.79
3504	113.00 - 113.50	34.50 - 35.00	4.837	.321	204.10	4.990	.241	207.69
3505	113.00 - 113.50	35.00 - 35.50	4.735	.251	179.06	4.986	.240	195.80
3506	113.00 - 113.50	35.50 - 36.00	4.617	.217	149.28	4.971	.250	175.92
3507	113.00 - 113.50	36.00 - 36.50	4.380	.173	105.05	4.910	.269	145.82
3508	113.00 - 113.50	36.50 - 37.00	4.372	.167	83.66	4.913	.263	124.88
3509	113.00 - 113.50	37.00 - 37.50	4.352	.187	39.39	4.915	.259	92.74
3510	113.00 - 113.50	37.50 - 38.00	4.353	.170	39.21	4.916	.257	87.89
3511	113.00 - 113.50	38.00 - 38.50	4.415	.133	40.87	4.919	.255	133.24
3512	113.00 - 113.50	38.50 - 39.00	4.420	.132	74.49	4.920	.255	148.01
3513	113.00 - 113.50	39.00 - 39.50	4.388	.150	89.72	4.922	.253	164.05
3514	113.00 - 113.50	39.50 - 40.00	4.430	.134	100.04	4.917	.255	185.06
3515	113.00 - 113.50	40.00 - 40.50	4.430	.134	92.19	4.033	.192	113.47
3516	113.00 - 113.50	40.50 - 41.00	4.428	.138	77.31	4.016	.184	110.59
3517	113.00 - 113.50	41.00 - 41.50	4.442	.136	82.53	4.008	.179	101.71
3518	113.00 - 113.50	41.50 - 42.00	4.247	.181	57.37	4.123	.142	97.78
3519	113.00 - 113.50	42.00 - 42.50	4.474	.199	37.42	4.067	.239	100.16
3520	113.00 - 113.50	42.50 - 43.00	4.485	.196	89.89	4.085	.248	98.91
3521	113.00 - 113.50	43.00 - 43.50	4.480	.196	109.54	4.094	.255	90.21
3522	113.00 - 113.50	43.50 - 44.00	4.542	.165	118.48	4.092	.256	78.43
3523	113.00 - 113.50	44.00 - 44.50	4.644	.141	118.22	4.091	.255	67.24
3524	113.00 - 113.50	44.50 - 45.00	4.628	.137	101.22	4.078	.251	54.85
3525	113.00 - 113.50	45.00 - 45.50	4.610	.146	53.48	4.172	.319	46.74
3526	113.00 - 113.50	45.50 - 46.00	4.622	.138	86.75	4.167	.315	73.00
3527	113.00 - 113.50	46.00 - 46.50	4.618	.139	69.55	4.155	.305	73.18
3528	113.00 - 113.50	46.50 - 47.00	4.605	.145	45.93	4.152	.303	50.14
3529	113.00 - 113.50	47.00 - 47.50	4.598	.151	65.55	4.309	.240	41.72
3530	113.00 - 113.50	47.50 - 48.00	4.396	.111	50.55	4.305	.133	59.86
3531	113.00 - 113.50	48.00 - 48.50	4.368	.118	73.13	4.252	.161	46.27
3532	113.00 - 113.50	48.50 - 49.00	4.362	.127	95.11	4.232	.169	80.51
3533	113.00 - 113.50	49.00 - 49.50	4.288	.145	91.87	4.211	.182	85.16
3534	113.00 - 113.50	49.50 - 50.00	3.915	.135	103.62	4.203	.189	88.45
3535	113.50 - 114.00	31.00 - 31.50	4.734	.431	214.38	4.790	.303	25.21

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3536	113.50 - 114.00	31.50 - 32.00	4.747	.411	180.68	4.783	.299	36.14
3537	113.50 - 114.00	32.00 - 32.50	4.756	.403	155.12	4.777	.295	50.64
3538	113.50 - 114.00	32.50 - 33.00	4.764	.396	140.02	4.729	.290	89.15
3539	113.50 - 114.00	33.00 - 33.50	4.775	.380	151.07	4.697	.271	111.82
3540	113.50 - 114.00	33.50 - 34.00	4.942	.332	184.84	4.733	.273	132.33
3541	113.50 - 114.00	34.00 - 34.50	4.946	.331	201.88	4.543	.202	137.99
3542	113.50 - 114.00	34.50 - 35.00	4.907	.286	200.21	5.023	.232	183.38
3543	113.50 - 114.00	35.00 - 35.50	4.810	.230	177.25	5.019	.230	171.65
3544	113.50 - 114.00	35.50 - 36.00	4.723	.210	148.84	5.006	.235	152.48
3545	113.50 - 114.00	36.00 - 36.50	4.545	.160	113.08	4.961	.240	111.20
3546	113.50 - 114.00	36.50 - 37.00	4.467	.163	90.31	4.949	.235	98.85
3547	113.50 - 114.00	37.00 - 37.50	4.369	.188	38.48	4.936	.242	68.14
3548	113.50 - 114.00	37.50 - 38.00	4.371	.168	49.58	4.934	.241	95.51
3549	113.50 - 114.00	38.00 - 38.50	4.415	.133	78.41	4.935	.241	123.42
3550	113.50 - 114.00	38.50 - 39.00	4.420	.132	96.72	4.932	.243	143.56
3551	113.50 - 114.00	39.00 - 39.50	4.388	.150	108.17	4.934	.241	159.79
3552	113.50 - 114.00	39.50 - 40.00	4.430	.134	112.64	4.928	.245	183.27
3553	113.50 - 114.00	40.00 - 40.50	4.430	.134	100.67	3.970	.162	122.64
3554	113.50 - 114.00	40.50 - 41.00	4.428	.138	103.12	3.952	.143	121.42
3555	113.50 - 114.00	41.00 - 41.50	4.442	.136	103.99	3.939	.134	102.52
3556	113.50 - 114.00	41.50 - 42.00	4.247	.181	78.53	4.043	.121	45.86
3557	113.50 - 114.00	42.00 - 42.50	4.474	.199	82.36	4.036	.212	101.58
3558	113.50 - 114.00	42.50 - 43.00	4.485	.196	102.72	4.074	.237	105.00
3559	113.50 - 114.00	43.00 - 43.50	4.480	.196	114.35	4.082	.243	89.15
3560	113.50 - 114.00	43.50 - 44.00	4.542	.165	113.59	4.080	.243	67.19
3561	113.50 - 114.00	44.00 - 44.50	4.644	.141	124.25	4.079	.243	56.90
3562	113.50 - 114.00	44.50 - 45.00	4.628	.137	114.14	4.066	.238	62.60
3563	113.50 - 114.00	45.00 - 45.50	4.612	.144	97.27	4.174	.321	72.98
3564	113.50 - 114.00	45.50 - 46.00	4.624	.135	101.96	4.169	.317	83.24
3565	113.50 - 114.00	46.00 - 46.50	4.620	.136	91.12	4.157	.307	83.13
3566	113.50 - 114.00	46.50 - 47.00	4.608	.141	74.93	4.154	.305	68.39
3567	113.50 - 114.00	47.00 - 47.50	4.601	.147	40.01	4.311	.242	55.48
3568	113.50 - 114.00	47.50 - 48.00	4.399	.108	62.13	4.304	.134	34.55
3569	113.50 - 114.00	48.00 - 48.50	4.371	.114	41.64	4.252	.161	41.47
3570	113.50 - 114.00	48.50 - 49.00	4.363	.125	86.62	4.232	.169	71.22

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	C(N)	R(N)
3571	113.50 - 114.00	49.00 - 49.50	4.290	.141	114.81	4.211	.182	59.03
3572	113.50 - 114.00	49.50 - 50.00	3.923	.124	116.06	4.207	.189	63.74
3573	114.00 - 114.50	31.00 - 31.50	4.671	.376	162.88	4.922	.233	18.61
3574	114.00 - 114.50	31.50 - 32.00	4.706	.357	130.41	4.938	.242	35.71
3575	114.00 - 114.50	32.00 - 32.50	4.714	.351	100.68	4.934	.240	74.72
3576	114.00 - 114.50	32.50 - 33.00	4.720	.342	68.52	4.933	.239	98.68
3577	114.00 - 114.50	33.00 - 33.50	4.756	.319	98.81	4.902	.234	115.23
3578	114.00 - 114.50	33.50 - 34.00	4.762	.315	120.79	4.883	.224	129.93
3579	114.00 - 114.50	34.00 - 34.50	4.774	.301	142.06	5.156	.242	168.45
3580	114.00 - 114.50	34.50 - 35.00	4.778	.295	152.73	5.096	.231	168.23
3581	114.00 - 114.50	35.00 - 35.50	4.739	.258	139.19	5.061	.227	155.43
3582	114.00 - 114.50	35.50 - 36.00	4.782	.291	116.12	5.057	.222	135.15
3583	114.00 - 114.50	36.00 - 36.50	4.983	.257	121.04	5.048	.222	115.35
3584	114.00 - 114.50	36.50 - 37.00	4.859	.255	125.96	5.002	.223	84.51
3585	114.00 - 114.50	37.00 - 37.50	4.753	.256	73.86	4.988	.219	30.27
3586	114.00 - 114.50	37.50 - 38.00	4.781	.314	124.01	4.961	.227	81.64
3587	114.00 - 114.50	38.00 - 38.50	4.763	.311	143.17	4.960	.224	112.65
3588	114.00 - 114.50	38.50 - 39.00	4.775	.310	159.69	4.959	.224	133.83
3589	114.00 - 114.50	39.00 - 39.50	4.793	.300	170.59	4.953	.228	124.77
3590	114.00 - 114.50	39.50 - 40.00	4.747	.312	157.08	4.954	.227	174.56
3591	114.00 - 114.50	40.00 - 40.50	4.742	.313	80.76	4.952	.225	198.98
3592	114.00 - 114.50	40.50 - 41.00	4.741	.313	149.87	4.141	.153	142.46
3593	114.00 - 114.50	41.00 - 41.50	4.743	.312	157.56	4.173	.164	134.22
3594	114.00 - 114.50	41.50 - 42.00	4.829	.336	164.55	4.215	.201	113.00
3595	114.00 - 114.50	42.00 - 42.50	4.447	.204	109.72	4.068	.155	118.19
3596	114.00 - 114.50	42.50 - 43.00	4.461	.197	101.58	4.099	.179	113.85
3597	114.00 - 114.50	43.00 - 43.50	4.456	.197	113.05	4.106	.184	88.31
3598	114.00 - 114.50	43.50 - 44.00	4.518	.174	66.58	4.061	.225	39.17
3599	114.00 - 114.50	44.00 - 44.50	4.626	.149	114.57	4.053	.220	27.96
3600	114.00 - 114.50	44.50 - 45.00	4.611	.141	116.80	4.046	.216	48.05
3601	114.00 - 114.50	45.00 - 45.50	4.612	.144	116.82	4.168	.316	76.70
3602	114.00 - 114.50	45.50 - 46.00	4.624	.135	117.55	4.163	.312	89.69
3603	114.00 - 114.50	46.00 - 46.50	4.620	.136	109.38	4.151	.301	89.46
3604	114.00 - 114.50	46.50 - 47.00	4.608	.141	93.91	4.149	.300	73.68
3605	114.00 - 114.50	47.00 - 47.50	4.601	.147	58.80	4.305	.239	51.57

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3606	114.00 - 114.50	47.50 - 48.00	4.399	.108	49.78	4.302	.135	15.36
3607	114.00 - 114.50	48.00 - 48.50	4.371	.114	29.22	4.249	.163	35.13
3608	114.00 - 114.50	48.50 - 49.00	4.363	.125	83.59	4.232	.169	67.83
3609	114.00 - 114.50	49.00 - 49.50	4.290	.141	121.88	4.211	.182	56.91
3610	114.00 - 114.50	49.50 - 50.00	3.923	.124	123.71	4.203	.189	35.83
3611	114.50 - 115.00	31.00 - 31.50	4.691	.360	145.71	4.937	.241	38.58
3612	114.50 - 115.00	31.50 - 32.00	4.761	.330	110.27	4.993	.210	63.48
3613	114.50 - 115.00	32.00 - 32.50	4.768	.326	49.13	4.990	.209	69.70
3614	114.50 - 115.00	32.50 - 33.00	4.784	.317	80.46	4.991	.208	79.54
3615	114.50 - 115.00	33.00 - 33.50	4.814	.299	49.83	4.964	.205	104.18
3616	114.50 - 115.00	33.50 - 34.00	4.904	.324	108.53	4.946	.197	116.84
3617	114.50 - 115.00	34.00 - 34.50	4.914	.312	137.42	5.181	.242	151.65
3618	114.50 - 115.00	34.50 - 35.00	4.917	.307	153.35	5.128	.229	153.86
3619	114.50 - 115.00	35.00 - 35.50	4.903	.288	142.78	5.099	.221	143.22
3620	114.50 - 115.00	35.50 - 36.00	4.930	.305	74.91	5.097	.218	98.44
3621	114.50 - 115.00	36.00 - 36.50	5.203	.331	62.01	5.092	.214	86.09
3622	114.50 - 115.00	36.50 - 37.00	5.136	.349	147.65	5.054	.209	84.16
3623	114.50 - 115.00	37.00 - 37.50	5.054	.366	168.57	5.038	.206	67.35
3624	114.50 - 115.00	37.50 - 38.00	5.044	.410	190.81	4.985	.210	78.39
3625	114.50 - 115.00	38.00 - 38.50	5.030	.413	204.70	4.984	.208	101.32
3626	114.50 - 115.00	38.50 - 39.00	5.038	.409	215.96	4.980	.209	123.04
3627	114.50 - 115.00	39.00 - 39.50	5.035	.406	219.16	4.972	.213	120.59
3628	114.50 - 115.00	39.50 - 40.00	5.003	.425	208.50	4.971	.215	166.23
3629	114.50 - 115.00	40.00 - 40.50	4.881	.380	165.27	4.968	.215	190.42
3630	114.50 - 115.00	40.50 - 41.00	4.872	.388	174.32	4.252	.155	150.28
3631	114.50 - 115.00	41.00 - 41.50	4.870	.389	186.23	4.253	.148	152.62
3632	114.50 - 115.00	41.50 - 42.00	4.897	.409	194.65	4.243	.205	144.63
3633	114.50 - 115.00	42.00 - 42.50	4.421	.219	118.84	3.974	.077	127.43
3634	114.50 - 115.00	42.50 - 43.00	4.426	.213	52.23	4.004	.101	114.66
3635	114.50 - 115.00	43.00 - 43.50	4.413	.218	113.27	4.014	.108	85.85
3636	114.50 - 115.00	43.50 - 44.00	4.239	.083	87.50	3.967	.149	43.01
3637	114.50 - 115.00	44.00 - 44.50	4.460	.151	60.91	3.952	.138	18.46
3638	114.50 - 115.00	44.50 - 45.00	4.438	.120	79.12	3.934	.135	47.48
3639	114.50 - 115.00	45.00 - 45.50	4.616	.153	118.97	4.149	.300	52.19
3640	114.50 - 115.00	45.50 - 46.00	4.627	.147	131.25	4.147	.299	92.99

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3641	114.50 - 115.00	46.00 - 46.50	4.623	.151	126.17	4.137	.290	95.13
3642	114.50 - 115.00	46.50 - 47.00	4.614	.157	111.85	4.135	.289	79.24
3643	114.50 - 115.00	47.00 - 47.50	4.610	.162	92.37	4.293	.234	60.12
3644	114.50 - 115.00	47.50 - 48.00	4.435	.140	78.03	4.293	.134	34.69
3645	114.50 - 115.00	48.00 - 48.50	4.409	.148	66.77	4.295	.289	54.91
3646	114.50 - 115.00	48.50 - 49.00	4.402	.158	99.59	4.285	.290	73.95
3647	114.50 - 115.00	49.00 - 49.50	4.290	.141	129.61	4.272	.293	53.48
3648	114.50 - 115.00	49.50 - 50.00	3.923	.124	129.78	4.266	.296	15.86
3649	115.00 - 115.50	31.00 - 31.50	4.745	.334	136.17	4.988	.208	59.03
3650	115.00 - 115.50	31.50 - 32.00	4.807	.325	99.87	4.998	.213	59.05
3651	115.00 - 115.50	32.00 - 32.50	4.850	.294	55.97	4.998	.212	66.23
3652	115.00 - 115.50	32.50 - 33.00	4.864	.286	62.72	4.999	.211	70.63
3653	115.00 - 115.50	33.00 - 33.50	4.884	.270	46.81	4.973	.209	78.89
3654	115.00 - 115.50	33.50 - 34.00	4.962	.288	91.92	4.955	.201	92.31
3655	115.00 - 115.50	34.00 - 34.50	4.971	.277	119.11	5.188	.241	129.58
3656	115.00 - 115.50	34.50 - 35.00	4.985	.264	141.90	5.138	.226	137.83
3657	115.00 - 115.50	35.00 - 35.50	4.970	.248	143.97	5.110	.218	133.18
3658	115.00 - 115.50	35.50 - 36.00	4.997	.262	117.33	5.109	.214	116.72
3659	115.00 - 115.50	36.00 - 36.50	5.287	.285	67.49	5.104	.210	94.96
3660	115.00 - 115.50	36.50 - 37.00	5.244	.295	163.59	5.067	.205	68.59
3661	115.00 - 115.50	37.00 - 37.50	5.185	.303	204.94	5.051	.202	52.73
3662	115.00 - 115.50	37.50 - 38.00	5.164	.344	220.63	4.995	.203	55.90
3663	115.00 - 115.50	38.00 - 38.50	5.136	.350	224.23	4.993	.201	88.24
3664	115.00 - 115.50	38.50 - 39.00	5.101	.380	222.52	4.986	.205	110.52
3665	115.00 - 115.50	39.00 - 39.50	5.095	.381	222.88	4.978	.209	133.31
3666	115.00 - 115.50	39.50 - 40.00	5.071	.401	218.19	4.974	.212	158.52
3667	115.00 - 115.50	40.00 - 40.50	4.963	.371	181.65	4.969	.215	176.73
3668	115.00 - 115.50	40.50 - 41.00	4.949	.385	151.45	4.247	.152	136.86
3669	115.00 - 115.50	41.00 - 41.50	4.909	.414	184.20	4.235	.136	149.19
3670	115.00 - 115.50	41.50 - 42.00	4.902	.409	207.42	4.191	.170	149.88
3671	115.00 - 115.50	42.00 - 42.50	4.394	.257	134.61	3.886	.105	128.50
3672	115.00 - 115.50	42.50 - 43.00	4.362	.259	106.31	3.876	.113	111.06
3673	115.00 - 115.50	43.00 - 43.50	4.349	.271	116.41	3.875	.111	84.49
3674	115.00 - 115.50	43.50 - 44.00	4.245	.191	95.11	3.750	.223	47.84
3675	115.00 - 115.50	44.00 - 44.50	4.456	.214	90.18	3.724	.234	22.29

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3676	115.00 - 115.50	44.50 - 45.00	4.433	.184	35.15	3.699	.264	29.50
3677	115.00 - 115.50	45.00 - 45.50	4.451	.147	100.04	4.085	.249	77.96
3678	115.00 - 115.50	45.50 - 46.00	4.481	.139	128.56	4.095	.257	98.52
3679	115.00 - 115.50	46.00 - 46.50	4.481	.139	127.38	4.092	.254	100.68
3680	115.00 - 115.50	46.50 - 47.00	4.472	.145	111.99	4.090	.253	86.83
3681	115.00 - 115.50	47.00 - 47.50	4.468	.151	61.10	4.249	.224	76.33
3682	115.00 - 115.50	47.50 - 48.00	4.393	.145	89.07	4.279	.144	63.77
3683	115.00 - 115.50	48.00 - 48.50	4.373	.151	93.96	4.287	.292	73.80
3684	115.00 - 115.50	48.50 - 49.00	4.363	.166	115.21	4.278	.293	81.72
3685	115.00 - 115.50	49.00 - 49.50	4.287	.146	139.51	4.272	.293	61.90
3686	115.00 - 115.50	49.50 - 50.00	3.913	.138	135.44	4.266	.296	38.07
3687	115.50 - 116.00	31.00 - 31.50	4.774	.326	128.25	4.988	.210	56.96
3688	115.50 - 116.00	31.50 - 32.00	4.815	.318	65.34	5.012	.210	53.88
3689	115.50 - 116.00	32.00 - 32.50	5.005	.372	55.41	5.015	.209	58.85
3690	115.50 - 116.00	32.50 - 33.00	5.016	.365	30.56	5.016	.208	41.98
3691	115.50 - 116.00	33.00 - 33.50	5.032	.349	35.11	4.991	.204	38.95
3692	115.50 - 116.00	33.50 - 34.00	5.079	.394	70.45	4.974	.197	59.50
3693	115.50 - 116.00	34.00 - 34.50	5.088	.383	87.82	5.195	.244	92.98
3694	115.50 - 116.00	34.50 - 35.00	5.101	.371	134.19	5.146	.229	121.18
3695	115.50 - 116.00	35.00 - 35.50	5.094	.359	152.45	5.120	.221	123.17
3696	115.50 - 116.00	35.50 - 36.00	5.114	.366	149.89	5.119	.217	110.41
3697	115.50 - 116.00	36.00 - 36.50	5.400	.380	173.78	5.114	.213	84.81
3698	115.50 - 116.00	36.50 - 37.00	5.363	.393	207.34	5.073	.208	46.90
3699	115.50 - 116.00	37.00 - 37.50	5.308	.410	230.87	5.058	.205	32.10
3700	115.50 - 116.00	37.50 - 38.00	5.276	.454	239.41	4.997	.203	48.72
3701	115.50 - 116.00	38.00 - 38.50	5.249	.464	237.70	4.994	.202	77.31
3702	115.50 - 116.00	38.50 - 39.00	5.096	.387	208.71	4.985	.206	85.40
3703	115.50 - 116.00	39.00 - 39.50	5.089	.389	208.04	4.978	.210	123.68
3704	115.50 - 116.00	39.50 - 40.00	5.061	.415	205.75	4.972	.214	149.73
3705	115.50 - 116.00	40.00 - 40.50	4.954	.385	165.65	4.966	.217	132.30
3706	115.50 - 116.00	40.50 - 41.00	4.938	.401	66.90	4.234	.146	105.72
3707	115.50 - 116.00	41.00 - 41.50	4.896	.432	168.67	4.224	.129	133.15
3708	115.50 - 116.00	41.50 - 42.00	4.880	.439	210.15	4.205	.067	153.03
3709	115.50 - 116.00	42.00 - 42.50	4.345	.320	150.91	3.886	.106	130.31
3710	115.50 - 116.00	42.50 - 43.00	4.234	.318	125.63	3.866	.102	116.49

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
3711	115.50 - 116.00	43.00 - 43.50	4.220	.329	101.00	3.857	.095	93.81
3712	115.50 - 116.00	43.50 - 44.00	4.081	.196	61.11	3.734	.209	59.67
3713	115.50 - 116.00	44.00 - 44.50	4.101	.183	65.05	3.704	.214	31.18
3714	115.50 - 116.00	44.50 - 45.00	4.057	.103	52.97	3.680	.246	47.92
3715	115.50 - 116.00	45.00 - 45.50	4.426	.172	107.98	3.984	.340	85.31
3716	115.50 - 116.00	45.50 - 46.00	4.467	.163	135.45	4.013	.353	102.63
3717	115.50 - 116.00	46.00 - 46.50	4.467	.163	136.81	4.013	.353	104.31
3718	115.50 - 116.00	46.50 - 47.00	4.456	.170	123.32	4.010	.352	93.77
3719	115.50 - 116.00	47.00 - 47.50	4.451	.178	96.89	4.282	.138	102.13
3720	115.50 - 116.00	47.50 - 48.00	4.382	.160	75.69	4.240	.148	87.97
3721	115.50 - 116.00	48.00 - 48.50	4.373	.164	98.82	4.278	.289	92.49
3722	115.50 - 116.00	48.50 - 49.00	4.368	.171	126.73	4.279	.292	93.54
3723	115.50 - 116.00	49.00 - 49.50	4.276	.148	148.35	4.277	.294	79.53
3724	115.50 - 116.00	49.50 - 50.00	3.882	.134	139.31	4.272	.296	67.36
3725	116.00 - 116.50	31.00 - 31.50	4.779	.322	126.98	4.996	.203	53.69
3726	116.00 - 116.50	31.50 - 32.00	4.842	.318	80.75	5.032	.210	48.00
3727	116.00 - 116.50	32.00 - 32.50	5.025	.367	83.45	5.038	.210	79.42
3728	116.00 - 116.50	32.50 - 33.00	5.035	.360	73.74	5.038	.209	52.90
3729	116.00 - 116.50	33.00 - 33.50	5.049	.346	48.76	5.015	.205	26.54
3730	116.00 - 116.50	33.50 - 34.00	5.095	.390	72.86	5.000	.198	51.39
3731	116.00 - 116.50	34.00 - 34.50	5.104	.379	77.85	5.207	.246	70.24
3732	116.00 - 116.50	34.50 - 35.00	5.116	.368	92.99	5.160	.231	103.12
3733	116.00 - 116.50	35.00 - 35.50	5.109	.357	139.10	5.133	.224	111.10
3734	116.00 - 116.50	35.50 - 36.00	5.117	.364	154.47	5.132	.219	101.44
3735	116.00 - 116.50	36.00 - 36.50	5.404	.377	211.25	5.126	.216	80.09
3736	116.00 - 116.50	36.50 - 37.00	5.366	.390	218.65	5.087	.211	41.30
3737	116.00 - 116.50	37.00 - 37.50	5.311	.410	224.71	5.072	.207	13.21
3738	116.00 - 116.50	37.50 - 38.00	5.272	.457	224.69	4.994	.203	40.23
3739	116.00 - 116.50	38.00 - 38.50	5.236	.474	214.24	4.991	.202	71.78
3740	116.00 - 116.50	38.50 - 39.00	5.075	.406	180.42	4.981	.207	57.55
3741	116.00 - 116.50	39.00 - 39.50	5.060	.415	177.41	4.985	.209	116.72
3742	116.00 - 116.50	39.50 - 40.00	5.032	.441	180.51	4.980	.212	144.04
3743	116.00 - 116.50	40.00 - 40.50	4.919	.411	159.44	4.974	.215	127.66
3744	116.00 - 116.50	40.50 - 41.00	4.901	.429	138.24	4.299	.139	56.58
3745	116.00 - 116.50	41.00 - 41.50	4.854	.463	169.86	4.293	.123	119.02

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3746	116.00 - 116.50	41.50 - 42.00	4.823	.471	200.98	4.286	.081	145.98
3747	116.00 - 116.50	42.00 - 42.50	4.296	.343	151.67	3.786	.219	117.30
3748	116.00 - 116.50	42.50 - 43.00	4.126	.394	123.47	3.745	.198	110.67
3749	116.00 - 116.50	43.00 - 43.50	4.111	.402	83.83	3.736	.190	94.94
3750	116.00 - 116.50	43.50 - 44.00	3.986	.174	23.65	3.760	.132	77.79
3751	116.00 - 116.50	44.00 - 44.50	4.002	.173	37.65	3.706	.183	58.13
3752	116.00 - 116.50	44.50 - 45.00	4.056	.140	41.20	3.657	.272	41.40
3753	116.00 - 116.50	45.00 - 45.50	4.094	.080	88.34	3.976	.336	93.70
3754	116.00 - 116.50	45.50 - 46.00	4.170	.129	110.84	4.007	.349	111.00
3755	116.00 - 116.50	46.00 - 46.50	4.170	.129	114.57	4.007	.349	113.88
3756	116.00 - 116.50	46.50 - 47.00	4.155	.127	106.02	4.004	.348	107.06
3757	116.00 - 116.50	47.00 - 47.50	4.147	.135	79.12	4.276	.142	123.84
3758	116.00 - 116.50	47.50 - 48.00	4.094	.122	26.94	4.233	.153	111.09
3759	116.00 - 116.50	48.00 - 48.50	4.080	.117	63.70	4.275	.290	110.15
3760	116.00 - 116.50	48.50 - 49.00	4.072	.129	98.36	4.279	.292	107.01
3761	116.00 - 116.50	49.00 - 49.50	3.965	.136	123.09	4.277	.294	96.94
3762	116.00 - 116.50	49.50 - 50.00	3.907	.137	147.71	4.274	.295	89.38
3763	116.50 - 117.00	31.00 - 31.50	4.805	.322	130.01	5.009	.201	73.74
3764	116.50 - 117.00	31.50 - 32.00	4.871	.342	56.15	5.025	.205	65.93
3765	116.50 - 117.00	32.00 - 32.50	5.043	.378	86.70	5.033	.207	69.43
3766	116.50 - 117.00	32.50 - 33.00	5.058	.372	103.43	5.036	.206	57.11
3767	116.50 - 117.00	33.00 - 33.50	5.072	.358	74.38	5.016	.203	50.90
3768	116.50 - 117.00	33.50 - 34.00	5.116	.399	50.64	5.003	.199	39.11
3769	116.50 - 117.00	34.00 - 34.50	5.124	.389	45.60	5.211	.246	49.95
3770	116.50 - 117.00	34.50 - 35.00	5.137	.377	107.35	5.163	.230	67.31
3771	116.50 - 117.00	35.00 - 35.50	5.129	.369	99.64	5.137	.223	86.42
3772	116.50 - 117.00	35.50 - 36.00	5.135	.377	145.17	5.136	.219	68.91
3773	116.50 - 117.00	36.00 - 36.50	5.424	.387	190.59	5.139	.220	82.89
3774	116.50 - 117.00	36.50 - 37.00	5.401	.393	204.90	5.103	.214	51.33
3775	116.50 - 117.00	37.00 - 37.50	5.353	.409	209.73	5.089	.210	24.63
3776	116.50 - 117.00	37.50 - 38.00	5.300	.449	203.77	5.016	.204	48.83
3777	116.50 - 117.00	38.00 - 38.50	5.268	.462	186.11	5.012	.203	75.27
3778	116.50 - 117.00	38.50 - 39.00	5.108	.397	146.43	5.004	.207	93.23
3779	116.50 - 117.00	39.00 - 39.50	5.084	.404	137.69	5.004	.210	118.02
3780	116.50 - 117.00	39.50 - 40.00	5.057	.430	152.89	4.996	.214	138.37

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3781	116.50 - 117.00	40.00 - 40.50	4.949	.402	146.38	4.991	.216	145.61
3782	116.50 - 117.00	40.50 - 41.00	4.932	.421	149.22	4.299	.245	80.75
3783	116.50 - 117.00	41.00 - 41.50	4.892	.450	167.15	4.296	.236	96.38
3784	116.50 - 117.00	41.50 - 42.00	4.875	.444	198.77	4.273	.219	124.37
3785	116.50 - 117.00	42.00 - 42.50	4.404	.313	165.53	4.041	.112	129.05
3786	116.50 - 117.00	42.50 - 43.00	4.246	.371	147.38	4.015	.098	132.07
3787	116.50 - 117.00	43.00 - 43.50	4.228	.391	110.70	4.005	.089	124.72
3788	116.50 - 117.00	43.50 - 44.00	3.895	.209	53.02	3.922	.143	101.01
3789	116.50 - 117.00	44.00 - 44.50	3.915	.195	61.71	3.897	.140	79.99
3790	116.50 - 117.00	44.50 - 45.00	3.986	.138	67.31	3.876	.147	68.48
3791	116.50 - 117.00	45.00 - 45.50	4.099	.105	93.61	4.125	.116	115.54
3792	116.50 - 117.00	45.50 - 46.00	4.183	.148	98.45	4.167	.103	143.50
3793	116.50 - 117.00	46.00 - 46.50	4.183	.148	109.56	4.167	.103	150.12
3794	116.50 - 117.00	46.50 - 47.00	4.150	.133	107.11	4.163	.106	145.45
3795	116.50 - 117.00	47.00 - 47.50	4.142	.143	87.11	4.236	.155	140.95
3796	116.50 - 117.00	47.50 - 48.00	4.089	.131	55.82	4.216	.174	131.45
3797	116.50 - 117.00	48.00 - 48.50	4.075	.127	35.95	4.271	.294	126.16
3798	116.50 - 117.00	48.50 - 49.00	4.066	.140	95.57	4.275	.296	119.97
3799	116.50 - 117.00	49.00 - 49.50	3.989	.145	130.41	4.275	.296	110.40
3800	116.50 - 117.00	49.50 - 50.00	3.945	.132	158.07	4.273	.296	100.75
3801	117.00 - 117.50	31.00 - 31.50	4.835	.348	155.36	4.962	.192	83.45
3802	117.00 - 117.50	31.50 - 32.00	4.887	.336	123.72	5.015	.202	50.72
3803	117.00 - 117.50	32.00 - 32.50	5.055	.370	135.23	5.023	.203	65.04
3804	117.00 - 117.50	32.50 - 33.00	5.076	.363	121.07	5.039	.204	89.08
3805	117.00 - 117.50	33.00 - 33.50	5.096	.346	71.71	5.019	.203	81.03
3806	117.00 - 117.50	33.50 - 34.00	5.140	.385	71.54	5.011	.201	69.01
3807	117.00 - 117.50	34.00 - 34.50	5.147	.377	62.43	5.215	.247	51.20
3808	117.00 - 117.50	34.50 - 35.00	5.158	.367	106.17	5.169	.230	88.53
3809	117.00 - 117.50	35.00 - 35.50	5.148	.361	124.45	5.145	.223	76.89
3810	117.00 - 117.50	35.50 - 36.00	5.155	.368	132.12	5.143	.219	95.38
3811	117.00 - 117.50	36.00 - 36.50	5.268	.377	88.53	5.147	.220	81.55
3812	117.00 - 117.50	36.50 - 37.00	5.247	.381	141.42	5.111	.215	70.68
3813	117.00 - 117.50	37.00 - 37.50	5.203	.395	147.15	5.098	.210	54.49
3814	117.00 - 117.50	37.50 - 38.00	5.158	.430	149.61	5.026	.203	65.01
3815	117.00 - 117.50	38.00 - 38.50	5.118	.447	126.64	5.023	.202	65.46

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3816	117.00 - 117.50	38.50 - 39.00	4.962	.381	83.57	5.014	.205	95.79
3817	117.00 - 117.50	39.00 - 39.50	5.102	.393	76.59	5.006	.209	110.24
3818	117.00 - 117.50	39.50 - 40.00	5.059	.430	122.28	4.998	.213	124.09
3819	117.00 - 117.50	40.00 - 40.50	4.947	.405	113.45	4.991	.216	110.66
3820	117.00 - 117.50	40.50 - 41.00	4.933	.421	106.77	4.298	.243	42.10
3821	117.00 - 117.50	41.00 - 41.50	4.898	.445	135.57	4.298	.238	53.52
3822	117.00 - 117.50	41.50 - 42.00	4.886	.435	183.53	4.276	.221	109.97
3823	117.00 - 117.50	42.00 - 42.50	2.545	.000	69.16	2.881	.147	67.28
3824	117.00 - 117.50	42.50 - 43.00	3.085	.297	81.83	2.296	.225	86.67
3825	117.00 - 117.50	43.00 - 43.50	3.163	.187	60.18	2.548	.000	86.35
3826	117.00 - 117.50	43.50 - 44.00	3.244	.075	49.78	3.012	.014	60.09
3827	117.00 - 117.50	44.00 - 44.50	3.244	.075	47.10	3.012	.014	23.31
3828	117.00 - 117.50	44.50 - 45.00	3.290	.023	23.14	3.012	.014	14.78
3829	117.00 - 117.50	45.00 - 45.50	3.355	.427	52.49	3.012	.014	44.26
3830	117.00 - 117.50	45.50 - 46.00	3.334	.433	24.01	2.923	.074	73.16
3831	117.00 - 117.50	46.00 - 46.50	3.281	.459	46.08	.000	.000	.00
3832	117.00 - 117.50	46.50 - 47.00	3.498	.282	64.95	.000	.000	.00
3833	117.00 - 117.50	47.00 - 47.50	3.571	.277	63.60	.000	.000	.00
3834	117.00 - 117.50	47.50 - 48.00	3.244	.075	21.17	.000	.000	.00
3835	117.00 - 117.50	48.00 - 48.50	3.244	.075	33.86	.000	.000	.00
3836	117.00 - 117.50	48.50 - 49.00	3.244	.075	55.95	.000	.000	.00
3837	117.00 - 117.50	49.00 - 49.50	2.722	.490	70.02	.000	.000	.00
3838	117.00 - 117.50	49.50 - 50.00	.000	.000	.00	3.821	.363	82.26
3839	117.50 - 118.00	31.00 - 31.50	4.835	.348	181.17	4.820	.163	115.34
3840	117.50 - 118.00	31.50 - 32.00	4.887	.336	158.48	4.999	.196	107.90
3841	117.50 - 118.00	32.00 - 32.50	5.062	.369	157.06	5.008	.195	105.53
3842	117.50 - 118.00	32.50 - 33.00	5.083	.361	131.14	5.022	.195	77.79
3843	117.50 - 118.00	33.00 - 33.50	5.108	.341	103.66	5.022	.193	80.02
3844	117.50 - 118.00	33.50 - 34.00	5.164	.369	62.88	5.028	.194	60.82
3845	117.50 - 118.00	34.00 - 34.50	5.170	.361	69.86	5.224	.253	43.91
3846	117.50 - 118.00	34.50 - 35.00	5.179	.354	76.32	5.186	.237	86.94
3847	117.50 - 118.00	35.00 - 35.50	5.171	.347	110.72	5.164	.231	76.14
3848	117.50 - 118.00	35.50 - 36.00	5.178	.353	114.46	5.164	.227	72.19
3849	117.50 - 118.00	36.00 - 36.50	5.292	.362	125.87	5.167	.228	76.07
3850	117.50 - 118.00	36.50 - 37.00	5.277	.362	89.01	5.133	.224	89.36

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
3851	117.50 - 118.00	37.00 - 37.50	5.236	.375	94.55	5.122	.219	71.21
3852	117.50 - 118.00	37.50 - 38.00	5.197	.404	128.63	5.055	.212	74.33
3853	117.50 - 118.00	38.00 - 38.50	5.162	.418	103.07	5.034	.200	73.29
3854	117.50 - 118.00	38.50 - 39.00	5.008	.348	36.91	5.026	.202	71.35
3855	117.50 - 118.00	39.00 - 39.50	5.150	.359	83.71	5.018	.205	76.61
3856	117.50 - 118.00	39.50 - 40.00	5.100	.397	95.59	5.008	.209	81.56
3857	117.50 - 118.00	40.00 - 40.50	4.965	.400	67.17	4.990	.215	134.84
3858	117.50 - 118.00	40.50 - 41.00	4.953	.414	47.69	4.297	.242	64.53
3859	117.50 - 118.00	41.00 - 41.50	4.923	.434	86.08	4.297	.237	56.25
3860	117.50 - 118.00	41.50 - 42.00	4.906	.426	173.27	4.274	.220	99.58
3861	117.50 - 118.00	42.00 - 42.50	2.545	.000	64.82	2.881	.147	58.76
3862	117.50 - 118.00	42.50 - 43.00	3.085	.297	97.61	2.296	.225	74.32
3863	117.50 - 118.00	43.00 - 43.50	3.163	.187	79.93	2.071	.000	73.97
3864	117.50 - 118.00	43.50 - 44.00	3.244	.075	69.34	2.957	.041	63.98
3865	117.50 - 118.00	44.00 - 44.50	3.244	.075	62.40	2.957	.041	37.84
3866	117.50 - 118.00	44.50 - 45.00	3.290	.023	51.33	2.957	.041	19.63
3867	117.50 - 118.00	45.00 - 45.50	3.514	.345	63.93	2.957	.041	43.19
3868	117.50 - 118.00	45.50 - 46.00	3.495	.358	44.89	2.923	.074	72.78
3869	117.50 - 118.00	46.00 - 46.50	3.448	.400	32.01	.000	.000	.00
3870	117.50 - 118.00	46.50 - 47.00	3.610	.247	57.65	.000	.000	.00
3871	117.50 - 118.00	47.00 - 47.50	3.650	.275	74.86	2.071	.000	98.03
3872	117.50 - 118.00	47.50 - 48.00	3.244	.075	44.91	2.071	.000	77.72
3873	117.50 - 118.00	48.00 - 48.50	3.244	.075	53.40	2.071	.000	69.64
3874	117.50 - 118.00	48.50 - 49.00	3.244	.075	70.78	2.071	.000	77.72
3875	117.50 - 118.00	49.00 - 49.50	2.722	.490	79.65	2.071	.000	98.03
3876	117.50 - 118.00	49.50 - 50.00	.000	.000	.00	3.821	.363	73.06
3877	118.00 - 118.50	32.00 - 32.50	5.075	.381	169.32	4.891	.163	112.36
3878	118.00 - 118.50	32.50 - 33.00	5.097	.373	99.21	4.916	.161	80.78
3879	118.00 - 118.50	33.00 - 33.50	5.122	.353	105.50	4.927	.162	86.75
3880	118.00 - 118.50	33.50 - 34.00	5.188	.368	44.03	4.955	.171	47.30
3881	118.00 - 118.50	34.00 - 34.50	5.209	.350	64.35	5.184	.236	37.32
3882	118.00 - 118.50	34.50 - 35.00	5.218	.342	78.50	5.184	.234	75.83
3883	118.00 - 118.50	35.00 - 35.50	5.211	.335	85.57	5.167	.229	70.86
3884	118.00 - 118.50	35.50 - 36.00	5.218	.341	68.21	5.167	.226	77.85
3885	118.00 - 118.50	36.00 - 36.50	5.330	.348	115.68	5.170	.226	78.18

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
3886	118.00 - 118.50	36.50 - 37.00	5.317	.348	48.29	5.137	.222	92.87
3887	118.00 - 118.50	37.00 - 37.50	5.280	.360	89.58	5.126	.217	84.76
3888	118.00 - 118.50	37.50 - 38.00	5.248	.383	104.64	5.059	.208	49.45
3889	118.00 - 118.50	38.00 - 38.50	5.204	.386	64.88	5.037	.196	59.57
3890	118.00 - 118.50	38.50 - 39.00	5.059	.310	73.16	5.028	.198	63.45
3891	118.00 - 118.50	39.00 - 39.50	5.206	.318	43.39	5.021	.200	47.66
3892	118.00 - 118.50	39.50 - 40.00	5.168	.345	53.83	5.011	.204	83.58
3893	118.00 - 118.50	40.00 - 40.50	5.026	.361	97.83	4.984	.210	138.41
3894	118.00 - 118.50	40.50 - 41.00	4.967	.404	102.52	4.334	.270	93.44
3895	118.00 - 118.50	41.00 - 41.50	4.930	.430	130.95	4.303	.244	93.17
3896	118.00 - 118.50	41.50 - 42.00	4.913	.422	176.52	4.278	.226	64.76
3897	118.00 - 118.50	42.00 - 42.50	2.545	.000	69.16	3.676	.135	70.68
3898	118.00 - 118.50	42.50 - 43.00	.000	.000	.00	3.627	.148	82.90
3899	118.00 - 118.5	43.00 - 43.50	.000	.000	.00	3.621	.141	102.15
3900	118.00 - 118.50	43.50 - 44.00	2.423	.000	85.22	2.923	.074	71.44
3901	118.00 - 118.50	44.00 - 44.50	2.423	.000	60.76	2.923	.074	43.95
3902	118.00 - 118.50	44.50 - 45.00	2.900	.000	64.00	2.923	.074	15.68
3903	118.00 - 118.50	45.00 - 45.50	3.471	.378	65.06	2.923	.074	45.43
3904	118.00 - 118.50	45.50 - 46.00	3.558	.299	42.21	2.884	.114	75.80
3905	118.00 - 118.50	46.00 - 46.50	3.539	.322	14.13	2.296	.225	98.98
3906	118.00 - 118.50	46.50 - 47.00	3.558	.299	46.83	2.296	.225	78.91
3907	118.00 - 118.50	47.00 - 47.50	3.646	.307	79.98	2.446	.074	70.94
3908	118.00 - 118.50	47.50 - 48.00	3.237	.195	69.48	2.446	.074	65.11
3909	118.00 - 118.50	48.00 - 48.50	3.114	.213	65.27	2.446	.074	61.13
3910	118.00 - 118.50	48.50 - 49.00	3.114	.213	76.71	2.071	.000	58.32
3911	118.00 - 118.50	49.00 - 49.50	3.040	.316	97.32	2.071	.000	83.50
3912	118.00 - 118.50	49.50 - 50.00	.000	.000	.00	3.821	.363	69.72
3913	118.50 - 119.00	32.00 - 32.50	5.048	.363	180.98	4.883	.161	88.60
3914	118.50 - 119.00	32.50 - 33.00	5.069	.362	147.50	4.908	.159	105.35
3915	118.50 - 119.00	33.00 - 33.50	5.091	.347	116.71	4.919	.159	86.88
3916	118.50 - 119.00	33.50 - 34.00	5.165	.364	78.16	4.950	.170	68.27
3917	118.50 - 119.00	34.00 - 34.50	5.196	.345	49.27	5.181	.236	53.28
3918	118.50 - 119.00	34.50 - 35.00	5.234	.336	53.83	5.185	.234	85.36
3919	118.50 - 119.00	35.00 - 35.50	5.244	.334	40.35	5.168	.229	66.81
3920	118.50 - 119.00	35.50 - 36.00	5.267	.347	80.52	5.168	.226	108.52

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3921	118.50 - 119.00	36.00 - 36.50	5.378	.353	101.96	5.172	.227	102.92
3922	118.50 - 119.00	36.50 - 37.00	5.376	.353	114.79	5.141	.224	112.80
3923	118.50 - 119.00	37.00 - 37.50	5.345	.362	96.63	5.130	.219	72.57
3924	118.50 - 119.00	37.50 - 38.00	5.317	.384	53.07	5.064	.210	66.87
3925	118.50 - 119.00	38.00 - 38.50	5.281	.386	106.91	5.042	.198	79.44
3926	118.50 - 119.00	38.50 - 39.00	5.152	.327	75.64	5.034	.199	69.99
3927	118.50 - 119.00	39.00 - 39.50	5.308	.331	48.94	5.027	.201	70.79
3928	118.50 - 119.00	39.50 - 40.00	5.282	.347	70.61	5.019	.204	97.90
3929	118.50 - 119.00	40.00 - 40.50	5.172	.383	116.51	4.990	.209	143.05
3930	118.50 - 119.00	40.50 - 41.00	5.104	.417	135.81	4.358	.277	100.17
3931	118.50 - 119.00	41.00 - 41.50	4.999	.450	152.32	4.300	.241	100.74
3932	118.50 - 119.00	41.50 - 42.00	4.942	.428	183.95	4.274	.224	90.39
3933	118.50 - 119.00	42.00 - 42.50	2.545	.000	80.79	3.676	.135	52.89
3934	118.50 - 119.00	42.50 - 43.00	.000	.000	.00	3.627	.148	62.26
3935	118.50 - 119.00	43.00 - 43.50	.000	.000	.00	3.621	.141	86.12
3936	118.50 - 119.00	43.50 - 44.00	2.423	.000	101.31	2.923	.074	82.63
3937	118.50 - 119.00	44.00 - 44.50	2.423	.000	81.81	2.923	.074	56.50
3938	118.50 - 119.00	44.50 - 45.00	2.900	.000	78.30	2.923	.074	38.76
3939	118.50 - 119.00	45.00 - 45.50	3.471	.378	65.03	2.923	.074	57.46
3940	118.50 - 119.00	45.50 - 46.00	3.558	.299	28.13	2.884	.114	84.98
3941	118.50 - 119.00	46.00 - 46.50	3.539	.322	30.49	2.296	.225	83.99
3942	118.50 - 119.00	46.50 - 47.00	3.653	.277	52.63	2.296	.225	59.02
3943	118.50 - 119.00	47.00 - 47.50	3.713	.253	77.08	2.446	.074	50.97
3944	118.50 - 119.00	47.50 - 48.00	3.376	.166	66.53	2.446	.074	48.10
3945	118.50 - 119.00	48.00 - 48.50	3.300	.155	61.28	2.446	.074	35.13
3946	118.50 - 119.00	48.50 - 49.00	3.300	.155	74.58	2.071	.000	42.64
3947	118.50 - 119.00	49.00 - 49.50	3.024	.300	89.82	2.071	.000	73.41
3948	118.50 - 119.00	49.50 - 50.00	.000	.000	.00	3.821	.363	73.06
3949	119.00 - 119.50	32.00 - 32.50	5.036	.370	195.81	4.877	.161	132.78
3950	119.00 - 119.50	32.50 - 33.00	5.058	.363	165.07	4.903	.158	91.27
3951	119.00 - 119.50	33.00 - 33.50	5.078	.354	132.45	4.914	.158	47.73
3952	119.00 - 119.50	33.50 - 34.00	5.153	.369	104.76	4.945	.169	77.53
3953	119.00 - 119.50	34.00 - 34.50	5.186	.350	67.81	5.178	.237	57.49
3954	119.00 - 119.50	34.50 - 35.00	5.243	.341	70.33	5.181	.234	96.94
3955	119.00 - 119.50	35.00 - 35.50	5.253	.338	31.24	5.168	.230	89.78

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3556	119.00 - 119.50	35.50 - 36.00	5.289	.348	90.55	5.169	.227	109.96
3557	119.00 - 119.50	36.00 - 36.50	5.400	.353	136.38	5.173	.228	125.00
3558	119.00 - 119.50	36.50 - 37.00	5.401	.352	146.17	5.142	.224	124.60
3559	119.00 - 119.50	37.00 - 37.50	5.372	.361	137.37	5.132	.220	116.94
3560	119.00 - 119.50	37.50 - 38.00	5.346	.382	118.20	5.066	.211	106.95
3561	119.00 - 119.50	38.00 - 38.50	5.314	.383	99.17	5.044	.199	70.82
3562	119.00 - 119.50	38.50 - 39.00	5.190	.330	100.84	5.036	.200	88.46
3563	119.00 - 119.50	39.00 - 39.50	5.348	.333	81.97	5.029	.202	105.52
3564	119.00 - 119.50	39.50 - 40.00	5.328	.342	71.78	5.020	.205	108.99
3565	119.00 - 119.50	40.00 - 40.50	5.236	.379	120.11	4.992	.210	140.88
3566	119.00 - 119.50	40.50 - 41.00	5.178	.408	118.86	4.378	.283	95.42
3567	119.00 - 119.50	41.00 - 41.50	5.048	.432	146.73	4.327	.254	99.42
3568	119.00 - 119.50	41.50 - 42.00	4.985	.417	187.10	4.280	.230	76.59
3569	119.00 - 119.50	42.00 - 42.50	2.789	.000	86.72	3.642	.141	28.03
3570	119.00 - 119.50	42.50 - 43.00	2.423	.000	84.61	3.627	.148	44.37
3571	119.00 - 119.50	43.00 - 43.50	2.423	.000	103.59	3.616	.149	74.25
3572	119.00 - 119.50	43.50 - 44.00	.000	.000	.00	2.534	.014	83.38
3573	119.00 - 119.50	44.00 - 44.50	.000	.000	.00	2.534	.014	60.94
3574	119.00 - 119.50	44.50 - 45.00	2.423	.000	73.76	2.534	.014	50.96
3575	119.00 - 119.50	45.00 - 45.50	3.418	.432	72.60	2.534	.014	60.94
3576	119.00 - 119.50	45.50 - 46.00	3.539	.322	48.30	2.534	.014	83.38
3577	119.00 - 119.50	46.00 - 46.50	3.539	.322	20.60	2.296	.225	73.55
3578	119.00 - 119.50	46.50 - 47.00	3.700	.240	48.63	2.296	.225	42.88
3579	119.00 - 119.50	47.00 - 47.50	3.758	.213	68.17	2.446	.074	28.91
3580	119.00 - 119.50	47.50 - 48.00	3.456	.164	51.21	2.446	.074	37.69
3581	119.00 - 119.50	48.00 - 48.50	3.376	.166	39.82	2.446	.074	14.57
3582	119.00 - 119.50	48.50 - 49.00	3.376	.166	60.34	2.071	.000	35.92
3583	119.00 - 119.50	49.00 - 49.50	3.024	.300	77.93	2.071	.000	69.72
3584	119.00 - 119.50	49.50 - 50.00	.000	.000	.00	3.821	.363	82.26
3585	119.50 - 120.00	32.00 - 32.50	4.948	.380	203.27	4.841	.163	149.53
3586	119.50 - 120.00	32.50 - 33.00	4.976	.371	171.29	4.870	.156	121.39
3587	119.50 - 120.00	33.00 - 33.50	5.001	.359	135.77	4.883	.154	94.88
3588	119.50 - 120.00	33.50 - 34.00	5.086	.376	84.60	4.915	.161	71.36
3589	119.50 - 120.00	34.00 - 34.50	5.125	.355	48.42	5.158	.236	37.04
3590	119.50 - 120.00	34.50 - 35.00	5.191	.345	69.85	5.163	.233	95.67

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
3991	119.50 - 120.00	35.00 - 35.50	5.235	.374	77.84	5.152	.228	112.59
3992	119.50 - 120.00	35.50 - 36.00	5.281	.378	104.21	5.155	.225	111.02
3993	119.50 - 120.00	36.00 - 36.50	5.414	.381	142.51	5.164	.226	116.95
3994	119.50 - 120.00	36.50 - 37.00	5.428	.375	152.53	5.137	.223	125.67
3995	119.50 - 120.00	37.00 - 37.50	5.403	.385	148.92	5.127	.218	130.33
3996	119.50 - 120.00	37.50 - 38.00	5.377	.405	147.59	5.061	.209	124.58
3997	119.50 - 120.00	38.00 - 38.50	5.347	.408	138.61	5.041	.197	111.86
3998	119.50 - 120.00	38.50 - 39.00	5.251	.364	86.20	5.032	.199	68.54
3999	119.50 - 120.00	39.00 - 39.50	5.410	.369	91.48	5.025	.201	89.16
4000	119.50 - 120.00	39.50 - 40.00	5.391	.379	86.63	5.016	.204	106.84
4001	119.50 - 120.00	40.00 - 40.50	5.295	.366	118.19	4.989	.209	108.28
4002	119.50 - 120.00	40.50 - 41.00	5.248	.395	58.30	4.389	.290	65.88
4003	119.50 - 120.00	41.00 - 41.50	5.145	.427	145.18	4.341	.263	95.53
4004	119.50 - 120.00	41.50 - 42.00	5.007	.397	186.24	4.296	.241	66.33
4005	119.50 - 120.00	42.00 - 42.50	2.423	.000	52.04	3.627	.148	10.11
4006	119.50 - 120.00	42.50 - 43.00	2.423	.000	62.44	3.627	.148	36.26
4007	119.50 - 120.00	43.00 - 43.50	2.423	.000	86.43	3.616	.149	69.72
4008	119.50 - 120.00	43.50 - 44.00	.000	.000	.00	2.446	.074	101.31
4009	119.50 - 120.00	44.00 - 44.50	.000	.000	.00	2.446	.074	81.81
4010	119.50 - 120.00	44.50 - 45.00	2.423	.000	84.73	2.446	.074	74.18
4011	119.50 - 120.00	45.00 - 45.50	3.418	.432	86.84	2.446	.074	81.81
4012	119.50 - 120.00	45.50 - 46.00	3.539	.322	63.92	2.446	.074	101.31
4013	119.50 - 120.00	46.00 - 46.50	3.623	.239	45.64	2.296	.225	69.72
4014	119.50 - 120.00	46.50 - 47.00	3.790	.141	28.04	2.296	.225	35.92
4015	119.50 - 120.00	47.00 - 47.50	3.856	.115	58.20	2.446	.074	11.63
4016	119.50 - 120.00	47.50 - 48.00	3.758	.125	42.53	2.446	.074	36.00
4017	119.50 - 120.00	48.00 - 48.50	3.721	.115	24.96	2.446	.074	34.34
4018	119.50 - 120.00	48.50 - 49.00	3.648	.203	56.76	2.071	.000	42.64
4019	119.50 - 120.00	49.00 - 49.50	3.383	.245	72.82	2.071	.000	73.41
4020	119.50 - 120.00	49.50 - 50.00	3.074	.328	97.56	3.821	.363	95.65
4021	120.00 - 120.50	33.00 - 33.50	4.986	.376	149.33	4.776	.162	108.09
4022	120.00 - 120.50	33.50 - 34.00	5.074	.389	116.49	4.812	.175	78.51
4023	120.00 - 120.50	34.00 - 34.50	5.114	.366	63.51	4.875	.141	68.52
4024	120.00 - 120.50	34.50 - 35.00	5.181	.354	94.89	4.887	.143	70.51
4025	120.00 - 120.50	35.00 - 35.50	5.226	.382	104.04	4.861	.171	82.88

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4026	120.00 - 120.50	35.50 - 36.00	5.273	.385	86.99	4.857	.177	48.02
4027	120.00 - 120.50	36.00 - 36.50	5.408	.387	124.23	4.878	.180	54.35
4028	120.00 - 120.50	36.50 - 37.00	5.426	.377	134.76	4.878	.180	89.28
4029	120.00 - 120.50	37.00 - 37.50	5.402	.386	109.66	4.862	.178	103.35
4030	120.00 - 120.50	37.50 - 38.00	5.377	.405	145.25	4.715	.216	99.09
4031	120.00 - 120.50	38.00 - 38.50	5.348	.406	144.47	4.644	.238	90.40
4032	120.00 - 120.50	38.50 - 39.00	5.252	.363	119.79	4.633	.229	69.87
4033	120.00 - 120.50	39.00 - 39.50	5.235	.367	66.30	4.622	.222	26.09
4034	120.00 - 120.50	39.50 - 40.00	5.216	.377	48.11	4.608	.211	40.90
4035	120.00 - 120.50	40.00 - 40.50	5.120	.364	80.14	4.562	.183	83.03
4036	120.00 - 120.50	40.50 - 41.00	5.070	.395	95.58	4.384	.295	64.67
4037	120.00 - 120.50	41.00 - 41.50	4.966	.430	127.19	4.338	.268	95.70
4038	120.00 - 120.50	41.50 - 42.00	4.825	.403	154.08	4.291	.247	77.14
4039	120.00 - 120.50	42.00 - 42.50	2.423	.000	27.43	3.627	.148	27.68
4040	120.00 - 120.50	42.50 - 43.00	2.423	.000	44.07	3.627	.148	44.35
4041	120.00 - 120.50	43.00 - 43.50	2.423	.000	74.25	3.627	.148	74.35
4042	120.00 - 120.50	43.50 - 44.00	.000	.000	.00	.000	.000	.00
4043	120.00 - 120.50	44.00 - 44.50	.000	.000	.00	.000	.000	.00
4044	120.00 - 120.50	44.50 - 45.00	2.423	.000	100.38	.000	.000	.00
4045	120.00 - 120.50	45.00 - 45.50	2.928	.328	82.21	.000	.000	.00
4046	120.00 - 120.50	45.50 - 46.00	3.373	.054	70.85	2.296	.225	99.45
4047	120.00 - 120.50	46.00 - 46.50	3.661	.018	59.92	2.597	.225	76.33
4048	120.00 - 120.50	46.50 - 47.00	3.850	.054	49.85	2.773	.225	58.90
4049	120.00 - 120.50	47.00 - 47.50	3.944	.105	50.99	2.835	.163	40.83
4050	120.00 - 120.50	47.50 - 48.00	3.961	.119	25.66	2.986	.137	63.87
4051	120.00 - 120.50	48.00 - 48.50	3.904	.109	28.53	2.884	.114	67.06
4052	120.00 - 120.50	48.50 - 49.00	3.747	.174	52.43	2.747	.074	70.03
4053	120.00 - 120.50	49.00 - 49.50	3.503	.189	65.70	2.534	.014	73.77
4054	120.00 - 120.50	49.50 - 50.00	3.074	.328	83.25	2.446	.074	97.56
4055	120.50 - 121.00	33.00 - 33.50	4.924	.392	160.52	4.706	.147	117.37
4056	120.50 - 121.00	33.50 - 34.00	5.023	.403	133.19	4.750	.161	94.88
4057	120.50 - 121.00	34.00 - 34.50	5.068	.376	83.24	4.768	.161	61.78
4058	120.50 - 121.00	34.50 - 35.00	5.144	.362	55.52	4.785	.166	56.77
4059	120.50 - 121.00	35.00 - 35.50	5.205	.396	87.31	4.734	.246	66.94
4060	120.50 - 121.00	35.50 - 36.00	5.255	.398	75.40	4.730	.258	32.12

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4061	120.50 - 121.00	36.00 - 36.50	5.395	.399	66.65	4.768	.262	51.89
4062	120.50 - 121.00	36.50 - 37.00	5.415	.388	91.44	4.771	.264	48.64
4063	120.50 - 121.00	37.00 - 37.50	5.401	.390	117.24	4.805	.270	83.10
4064	120.50 - 121.00	37.50 - 38.00	5.393	.398	131.95	4.760	.205	96.81
4065	120.50 - 121.00	38.00 - 38.50	5.379	.395	137.63	4.652	.295	93.73
4066	120.50 - 121.00	38.50 - 39.00	5.289	.352	129.90	4.638	.286	83.93
4067	120.50 - 121.00	39.00 - 39.50	5.275	.354	113.58	4.629	.280	64.42
4068	120.50 - 121.00	39.50 - 40.00	5.258	.362	89.83	4.610	.269	73.80
4069	120.50 - 121.00	40.00 - 40.50	5.169	.349	109.68	4.550	.234	59.47
4070	120.50 - 121.00	40.50 - 41.00	5.127	.375	64.86	4.519	.224	94.64
4071	120.50 - 121.00	41.00 - 41.50	5.039	.401	138.33	4.481	.204	111.46
4072	120.50 - 121.00	41.50 - 42.00	4.922	.382	163.45	4.445	.190	109.02
4073	120.50 - 121.00	42.00 - 42.50	2.423	.000	10.00	3.627	.148	51.55
4074	120.50 - 121.00	42.50 - 43.00	2.423	.000	35.92	3.627	.148	61.85
4075	120.50 - 121.00	43.00 - 43.50	2.423	.000	69.72	3.627	.148	85.60
4076	120.50 - 121.00	43.50 - 44.00	.000	.000	.00	.000	.000	.00
4077	120.50 - 121.00	44.00 - 44.50	.000	.000	.00	.000	.000	.00
4078	120.50 - 121.00	44.50 - 45.00	2.423	.000	100.38	.000	.000	.00
4079	120.50 - 121.00	45.00 - 45.50	2.928	.328	91.39	2.296	.225	99.92
4080	120.50 - 121.00	45.50 - 46.00	3.421	.028	73.46	2.597	.225	82.07
4081	120.50 - 121.00	46.00 - 46.50	3.784	.073	61.27	3.593	.705	98.68
4082	120.50 - 121.00	46.50 - 47.00	3.996	.109	38.61	3.722	.588	85.59
4083	120.50 - 121.00	47.00 - 47.50	4.082	.178	42.11	3.729	.579	77.37
4084	120.50 - 121.00	47.50 - 48.00	4.103	.196	28.69	3.736	.571	81.47
4085	120.50 - 121.00	48.00 - 48.50	4.059	.180	43.64	3.721	.584	93.94
4086	120.50 - 121.00	48.50 - 49.00	3.891	.225	43.54	3.036	.132	65.94
4087	120.50 - 121.00	49.00 - 49.50	3.620	.244	56.73	2.534	.014	60.09
4088	120.50 - 121.00	49.50 - 50.00	3.217	.272	77.31	2.446	.074	83.25
4089	121.00 - 121.50	34.00 - 34.50	5.048	.382	123.90	4.668	.223	57.22
4090	121.00 - 121.50	34.50 - 35.00	5.127	.367	103.65	4.688	.234	23.64
4091	121.00 - 121.50	35.00 - 35.50	5.190	.401	70.25	4.704	.242	58.17
4092	121.00 - 121.50	35.50 - 36.00	5.242	.403	90.10	4.718	.249	59.70
4093	121.00 - 121.50	36.00 - 36.50	5.382	.404	68.05	4.757	.253	48.15
4094	121.00 - 121.50	36.50 - 37.00	5.405	.391	51.23	4.760	.256	28.12
4095	121.00 - 121.50	37.00 - 37.50	5.397	.392	80.13	4.822	.279	66.46

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
4096	121.00 - 121.50	37.50 - 38.00	5.400	.392	105.97	4.817	.193	79.76
4097	121.00 - 121.50	38.00 - 38.50	5.390	.390	100.44	4.732	.254	91.75
4098	121.00 - 121.50	38.50 - 39.00	5.301	.346	123.47	4.722	.249	100.69
4099	121.00 - 121.50	39.00 - 39.50	5.288	.348	124.10	4.714	.244	96.32
4100	121.00 - 121.50	39.50 - 40.00	5.276	.356	67.68	4.699	.236	92.25
4101	121.00 - 121.50	40.00 - 40.50	5.189	.343	118.86	4.647	.208	70.10
4102	121.00 - 121.50	40.50 - 41.00	5.149	.367	120.90	4.622	.201	77.26
4103	121.00 - 121.50	41.00 - 41.50	5.067	.389	151.18	4.590	.189	118.51
4104	121.00 - 121.50	41.50 - 42.00	4.958	.374	171.42	4.563	.180	129.39
4105	121.00 - 121.50	42.00 - 42.50	2.724	.000	35.83	3.637	.148	65.64
4106	121.00 - 121.50	42.50 - 43.00	2.724	.000	54.71	3.627	.148	78.70
4107	121.00 - 121.50	43.00 - 43.50	2.724	.000	85.07	3.627	.148	100.36
4108	121.00 - 121.50	43.50 - 44.00	.000	.000	.00	.000	.000	.00
4109	121.00 - 121.50	44.00 - 44.50	.000	.000	.00	.000	.000	.00
4110	121.00 - 121.50	44.50 - 45.00	3.223	.101	95.24	2.746	.503	100.38
4111	121.00 - 121.50	45.00 - 45.50	3.223	.101	74.36	2.896	.375	83.14
4112	121.00 - 121.50	45.50 - 46.00	3.612	.013	70.62	2.984	.309	69.89
4113	121.00 - 121.50	46.00 - 46.50	3.936	.047	59.57	3.718	.621	85.48
4114	121.00 - 121.50	46.50 - 47.00	4.070	.103	42.41	3.824	.520	67.46
4115	121.00 - 121.50	47.00 - 47.50	4.122	.159	22.62	3.761	.552	57.10
4116	121.00 - 121.50	47.50 - 48.00	4.171	.169	31.06	3.776	.539	59.37
4117	121.00 - 121.50	48.00 - 48.50	4.188	.160	33.20	3.766	.546	75.19
4118	121.00 - 121.50	48.50 - 49.00	4.082	.177	26.12	3.155	.194	44.21
4119	121.00 - 121.50	49.00 - 49.50	3.902	.170	58.69	2.884	.114	58.51
4120	121.00 - 121.50	49.50 - 50.00	3.603	.258	78.14	2.685	.137	81.37
4121	121.50 - 122.00	34.00 - 34.50	5.033	.392	141.73	4.625	.203	43.11
4122	121.50 - 122.00	34.50 - 35.00	5.115	.375	70.58	4.648	.215	39.68
4123	121.50 - 122.00	35.00 - 35.50	5.178	.409	121.63	4.665	.223	72.63
4124	121.50 - 122.00	35.50 - 36.00	5.207	.398	117.17	4.679	.229	79.68
4125	121.50 - 122.00	36.00 - 36.50	5.352	.400	103.40	4.722	.236	60.54
4126	121.50 - 122.00	36.50 - 37.00	5.376	.386	49.60	4.724	.237	30.43
4127	121.50 - 122.00	37.00 - 37.50	5.371	.384	43.18	4.808	.271	37.01
4128	121.50 - 122.00	37.50 - 38.00	5.370	.374	64.93	4.837	.196	39.24
4129	121.50 - 122.00	38.00 - 38.50	5.361	.370	88.26	4.758	.255	66.63
4130	121.50 - 122.00	38.50 - 39.00	5.266	.317	98.61	4.752	.253	102.34

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4131	121.50 - 122.00	39.00 - 39.50	5.252	.319	117.53	4.750	.253	97.49
4132	121.50 - 122.00	39.50 - 40.00	5.240	.326	116.54	4.738	.247	64.14
4133	121.50 - 122.00	40.00 - 40.50	5.150	.300	91.06	4.692	.223	76.45
4134	121.50 - 122.00	40.50 - 41.00	5.111	.321	84.78	4.672	.217	63.66
4135	121.50 - 122.00	41.00 - 41.50	5.019	.332	149.17	4.643	.208	116.98
4136	121.50 - 122.00	41.50 - 42.00	4.870	.286	158.99	4.621	.199	132.02
4137	121.50 - 122.00	42.00 - 42.50	3.027	.278	65.38	3.023	.255	20.86
4138	121.50 - 122.00	42.50 - 43.00	2.724	.000	62.44	2.296	.225	35.92
4139	121.50 - 122.00	43.00 - 43.50	2.724	.000	86.42	2.296	.225	69.72
4140	121.50 - 122.00	43.50 - 44.00	2.423	.000	101.31	.000	.000	.00
4141	121.50 - 122.00	44.00 - 44.50	3.112	.212	94.99	.000	.000	.00
4142	121.50 - 122.00	44.50 - 45.00	3.475	.149	80.25	2.746	.503	84.73
4143	121.50 - 122.00	45.00 - 45.50	3.475	.149	61.33	2.896	.375	64.02
4144	121.50 - 122.00	45.50 - 46.00	3.688	.034	54.01	2.984	.309	50.38
4145	121.50 - 122.00	46.00 - 46.50	4.024	.053	54.80	3.693	.648	64.38
4146	121.50 - 122.00	46.50 - 47.00	4.131	.123	26.44	3.811	.533	37.96
4147	121.50 - 122.00	47.00 - 47.50	4.181	.176	22.69	3.749	.561	33.02
4148	121.50 - 122.00	47.50 - 48.00	4.227	.194	30.04	3.776	.539	33.10
4149	121.50 - 122.00	48.00 - 48.50	4.247	.193	28.28	3.766	.546	60.51
4150	121.50 - 122.00	48.50 - 49.00	4.125	.200	42.70	3.186	.212	20.53
4151	121.50 - 122.00	49.00 - 49.50	3.937	.184	54.87	2.986	.137	51.88
4152	121.50 - 122.00	49.50 - 50.00	3.650	.242	69.01	2.835	.163	79.81
4153	122.00 - 122.50	34.00 - 34.50	4.941	.365	158.26	4.602	.167	63.11
4154	122.00 - 122.50	34.50 - 35.00	5.038	.348	135.52	4.625	.176	80.05
4155	122.00 - 122.50	35.00 - 35.50	5.107	.395	141.30	4.643	.179	93.02
4156	122.00 - 122.50	35.50 - 36.00	5.141	.382	109.44	4.655	.184	94.72
4157	122.00 - 122.50	36.00 - 36.50	5.269	.369	113.60	4.711	.172	80.68
4158	122.00 - 122.50	36.50 - 37.00	5.293	.357	61.93	4.714	.173	43.94
4159	122.00 - 122.50	37.00 - 37.50	5.303	.346	47.66	4.876	.177	70.37
4160	122.00 - 122.50	37.50 - 38.00	5.301	.331	32.56	4.849	.186	61.49
4161	122.00 - 122.50	38.00 - 38.50	5.295	.327	43.22	4.790	.224	87.26
4162	122.00 - 122.50	38.50 - 39.00	5.163	.249	51.20	4.794	.229	100.01
4163	122.00 - 122.50	39.00 - 39.50	5.152	.248	95.00	4.794	.232	66.19
4164	122.00 - 122.50	39.50 - 40.00	5.139	.252	88.77	4.788	.228	62.64
4165	122.00 - 122.50	40.00 - 40.50	5.108	.273	124.74	4.749	.213	79.34

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4166	122.00 - 122.50	40.50 - 41.00	5.069	.290	131.64	4.730	.209	101.88
4167	122.00 - 122.50	41.00 - 41.50	4.955	.300	142.35	4.712	.205	115.05
4168	122.00 - 122.50	41.50 - 42.00	4.823	.292	145.87	4.698	.201	132.51
4169	122.00 - 122.50	42.00 - 42.50	3.027	.278	46.24	3.199	.255	56.69
4170	122.00 - 122.50	42.50 - 43.00	2.724	.000	54.71	2.839	.206	66.48
4171	122.00 - 122.50	43.00 - 43.50	2.724	.000	85.07	2.296	.225	74.25
4172	122.00 - 122.50	43.50 - 44.00	2.423	.000	85.22	.000	.000	.00
4173	122.00 - 122.50	44.00 - 44.50	3.262	.238	82.03	.000	.000	.00
4174	122.00 - 122.50	44.50 - 45.00	3.549	.172	66.24	2.746	.503	73.76
4175	122.00 - 122.50	45.00 - 45.50	3.549	.172	46.86	2.896	.375	47.93
4176	122.00 - 122.50	45.50 - 46.00	3.740	.061	29.34	2.984	.309	30.60
4177	122.00 - 122.50	46.00 - 46.50	4.036	.067	51.25	3.693	.648	37.06
4178	122.00 - 122.50	46.50 - 47.00	4.100	.133	27.02	3.811	.533	46.20
4179	122.00 - 122.50	47.00 - 47.50	4.147	.183	20.23	3.754	.555	13.88
4180	122.00 - 122.50	47.50 - 48.00	4.211	.206	21.75	3.781	.535	23.19
4181	122.00 - 122.50	48.00 - 48.50	4.237	.194	25.74	3.770	.542	51.50
4182	122.00 - 122.50	48.50 - 49.00	4.092	.236	30.53	3.199	.209	35.28
4183	122.00 - 122.50	49.00 - 49.50	3.965	.181	42.38	3.019	.103	51.63
4184	122.00 - 122.50	49.50 - 50.00	3.741	.205	60.72	2.835	.163	76.30
4185	122.50 - 123.00	34.00 - 34.50	4.862	.414	182.68	4.569	.158	110.67
4186	122.50 - 123.00	34.50 - 35.00	4.961	.398	167.20	4.589	.166	110.07
4187	122.50 - 123.00	35.00 - 35.50	5.036	.443	158.73	4.608	.171	113.33
4188	122.50 - 123.00	35.50 - 36.00	5.076	.428	140.04	4.619	.176	108.83
4189	122.50 - 123.00	36.00 - 36.50	5.198	.412	129.64	4.675	.166	79.62
4190	122.50 - 123.00	36.50 - 37.00	5.222	.395	100.84	4.679	.167	85.72
4191	122.50 - 123.00	37.00 - 37.50	5.237	.379	77.72	4.861	.180	105.55
4192	122.50 - 123.00	37.50 - 38.00	5.248	.357	37.62	4.841	.193	100.47
4193	122.50 - 123.00	38.00 - 38.50	5.252	.349	62.84	4.783	.228	53.31
4194	122.50 - 123.00	38.50 - 39.00	5.133	.254	37.47	4.798	.237	71.34
4195	122.50 - 123.00	39.00 - 39.50	5.121	.252	71.03	4.836	.221	82.52
4196	122.50 - 123.00	39.50 - 40.00	5.109	.256	110.48	4.872	.195	99.42
4197	122.50 - 123.00	40.00 - 40.50	5.075	.277	127.31	4.848	.190	77.30
4198	122.50 - 123.00	40.50 - 41.00	5.033	.295	130.76	4.840	.189	105.03
4199	122.50 - 123.00	41.00 - 41.50	4.926	.293	123.72	4.828	.187	89.34
4200	122.50 - 123.00	41.50 - 42.00	4.773	.270	125.09	4.817	.185	128.97

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4201	122.50 - 123.00	42.00 - 42.50	3.969	.502	45.78	3.199	.255	65.49
4202	122.50 - 123.00	42.50 - 43.00	2.928	.328	53.03	2.839	.206	75.53
4203	122.50 - 123.00	43.00 - 43.50	2.928	.328	87.08	2.296	.225	86.43
4204	122.50 - 123.00	43.50 - 44.00	2.423	.000	73.90	.000	.000	.00
4205	122.50 - 123.00	44.00 - 44.50	3.262	.238	66.51	.000	.000	.00
4206	122.50 - 123.00	44.50 - 45.00	3.549	.172	48.89	2.746	.503	69.72
4207	122.50 - 123.00	45.00 - 45.50	3.549	.172	33.18	2.896	.375	40.64
4208	122.50 - 123.00	45.50 - 46.00	3.773	.095	17.93	2.984	.309	12.68
4209	122.50 - 123.00	46.00 - 46.50	4.053	.092	52.07	3.693	.648	59.52
4210	122.50 - 123.00	46.50 - 47.00	4.105	.142	34.42	3.811	.533	55.27
4211	122.50 - 123.00	47.00 - 47.50	4.157	.196	20.34	3.754	.555	29.71
4212	122.50 - 123.00	47.50 - 48.00	4.219	.217	27.25	3.781	.535	32.67
4213	122.50 - 123.00	48.00 - 48.50	4.242	.199	25.90	3.770	.542	33.93
4214	122.50 - 123.00	48.50 - 49.00	4.092	.236	27.49	3.199	.209	22.27
4215	122.50 - 123.00	49.00 - 49.50	3.980	.189	21.73	3.019	.103	49.48
4216	122.50 - 123.00	49.50 - 50.00	3.741	.205	54.11	2.954	.145	76.75
4217	123.00 - 123.50	36.00 - 36.50	5.081	.326	140.01	4.622	.177	117.48
4218	123.00 - 123.50	36.50 - 37.00	5.105	.312	117.62	4.642	.181	114.99
4219	123.00 - 123.50	37.00 - 37.50	5.121	.294	94.94	4.843	.193	132.74
4220	123.00 - 123.50	37.50 - 38.00	5.132	.267	73.55	4.843	.195	125.71
4221	123.00 - 123.50	38.00 - 38.50	5.135	.258	46.28	4.787	.229	102.97
4222	123.00 - 123.50	38.50 - 39.00	5.128	.258	59.10	4.815	.244	77.68
4223	123.00 - 123.50	39.00 - 39.50	5.117	.256	54.07	4.856	.229	68.90
4224	123.00 - 123.50	39.50 - 40.00	5.104	.260	109.19	4.907	.193	89.36
4225	123.00 - 123.50	40.00 - 40.50	5.070	.283	118.44	4.902	.194	74.18
4226	123.00 - 123.50	40.50 - 41.00	5.027	.302	111.65	4.820	.282	83.27
4227	123.00 - 123.50	41.00 - 41.50	4.918	.301	75.26	4.811	.279	63.53
4228	123.00 - 123.50	41.50 - 42.00	4.764	.275	107.60	4.806	.276	105.93
4229	123.00 - 123.50	42.00 - 42.50	4.041	.467	81.59	3.388	.225	64.93
4230	123.00 - 123.50	42.50 - 43.00	2.928	.328	53.76	2.922	.187	73.39
4231	123.00 - 123.50	43.00 - 43.50	2.928	.328	81.03	2.597	.225	92.19
4232	123.00 - 123.50	43.50 - 44.00	2.423	.000	69.72	2.296	.225	103.14
4233	123.00 - 123.50	44.00 - 44.50	3.262	.238	58.65	.000	.000	.00
4234	123.00 - 123.50	44.50 - 45.00	3.549	.172	27.58	2.746	.503	73.76
4235	123.00 - 123.50	45.00 - 45.50	3.549	.172	16.24	2.896	.375	48.76

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4236	123.00 - 123.50	45.50 - 46.00	3.773	.095	38.71	2.984	.309	32.25
4237	123.00 - 123.50	46.00 - 46.50	4.036	.099	58.65	3.693	.648	76.07
4238	123.00 - 123.50	46.50 - 47.00	4.084	.133	45.40	3.811	.533	72.86
4239	123.00 - 123.50	47.00 - 47.50	4.136	.181	20.58	3.754	.555	55.06
4240	123.00 - 123.50	47.50 - 48.00	4.169	.214	26.13	3.781	.535	56.37
4241	123.00 - 123.50	48.00 - 48.50	4.197	.185	27.08	3.770	.542	57.03
4242	123.00 - 123.50	48.50 - 49.00	4.000	.272	26.95	3.199	.209	22.69
4243	123.00 - 123.50	49.00 - 49.50	3.888	.208	38.67	3.019	.103	51.61
4244	123.00 - 123.50	49.50 - 50.00	3.627	.179	54.83	2.954	.145	76.31
4245	123.50 - 124.00	36.00 - 36.50	5.056	.337	160.71	4.532	.183	135.65
4246	123.50 - 124.00	36.50 - 37.00	5.080	.324	140.69	4.557	.189	132.90
4247	123.50 - 124.00	37.00 - 37.50	5.099	.303	121.85	4.795	.203	150.63
4248	123.50 - 124.00	37.50 - 38.00	5.117	.271	106.09	4.846	.197	146.99
4249	123.50 - 124.00	38.00 - 38.50	5.123	.260	93.35	4.792	.233	126.13
4250	123.50 - 124.00	38.50 - 39.00	5.117	.260	96.43	4.852	.226	113.43
4251	123.50 - 124.00	39.00 - 39.50	5.105	.259	77.13	4.870	.216	90.90
4252	123.50 - 124.00	39.50 - 40.00	5.091	.264	108.53	4.915	.193	84.13
4253	123.50 - 124.00	40.00 - 40.50	5.055	.288	93.64	4.926	.194	51.03
4254	123.50 - 124.00	40.50 - 41.00	5.010	.309	78.09	4.864	.301	53.95
4255	123.50 - 124.00	41.00 - 41.50	4.897	.309	69.44	4.857	.299	85.72
4256	123.50 - 124.00	41.50 - 42.00	4.732	.272	86.76	4.852	.297	71.81
4257	123.50 - 124.00	42.00 - 42.50	4.074	.432	70.29	3.601	.212	64.28
4258	123.50 - 124.00	42.50 - 43.00	2.928	.328	47.16	3.299	.194	75.22
4259	123.50 - 124.00	43.00 - 43.50	2.928	.328	76.38	3.013	.154	78.81
4260	123.50 - 124.00	43.50 - 44.00	2.423	.000	73.90	2.685	.137	80.22
4261	123.50 - 124.00	44.00 - 44.50	3.262	.238	63.92	2.446	.074	88.70
4262	123.50 - 124.00	44.50 - 45.00	3.549	.172	46.43	2.821	.411	86.36
4263	123.50 - 124.00	45.00 - 45.50	3.549	.172	20.75	2.896	.375	66.80
4264	123.50 - 124.00	45.50 - 46.00	3.685	.116	50.14	2.896	.375	54.56
4265	123.50 - 124.00	46.00 - 46.50	3.959	.109	64.42	3.661	.685	95.93
4266	123.50 - 124.00	46.50 - 47.00	4.006	.132	49.00	3.782	.563	93.66
4267	123.50 - 124.00	47.00 - 47.50	4.054	.177	37.86	3.727	.576	79.06
4268	123.50 - 124.00	47.50 - 48.00	4.101	.220	40.76	3.742	.565	75.91
4269	123.50 - 124.00	48.00 - 48.50	4.150	.179	35.80	3.742	.565	47.84
4270	123.50 - 124.00	48.50 - 49.00	4.026	.186	23.32	3.121	.175	43.15

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4271	123.50 - 124.00	49.00 - 49.50	3.948	.161	51.64	2.884	.114	57.00
4272	123.50 - 124.00	49.50 - 50.00	3.802	.206	69.66	2.839	.206	73.77
4273	124.00 - 124.50	38.00 - 38.50	5.099	.266	127.13	4.733	.257	130.55
4274	124.00 - 124.50	38.50 - 39.00	5.092	.266	120.62	4.804	.244	92.72
4275	124.00 - 124.50	39.00 - 39.50	5.087	.266	76.56	4.832	.227	97.65
4276	124.00 - 124.50	39.50 - 40.00	5.072	.271	105.15	4.887	.197	69.47
4277	124.00 - 124.50	40.00 - 40.50	5.033	.299	49.69	4.902	.198	27.92
4278	124.00 - 124.50	40.50 - 41.00	4.986	.320	36.03	4.950	.194	50.14
4279	124.00 - 124.50	41.00 - 41.50	4.867	.322	29.50	4.945	.193	84.05
4280	124.00 - 124.50	41.50 - 42.00	4.687	.273	71.18	4.941	.192	101.72
4281	124.00 - 124.50	42.00 - 42.50	4.153	.472	38.15	3.871	.225	67.33
4282	124.00 - 124.50	42.50 - 43.00	2.928	.328	40.55	3.651	.242	64.20
4283	124.00 - 124.50	43.00 - 43.50	2.928	.328	75.17	3.473	.160	73.09
4284	124.00 - 124.50	43.50 - 44.00	2.423	.000	85.22	3.055	.117	66.16
4285	124.00 - 124.50	44.00 - 44.50	3.262	.238	76.07	3.003	.088	83.12
4286	124.00 - 124.50	44.50 - 45.00	3.524	.198	62.92	2.865	.367	94.55
4287	124.00 - 124.50	45.00 - 45.50	3.524	.198	46.17	2.746	.503	80.66
4288	124.00 - 124.50	45.50 - 46.00	3.612	.189	62.89	2.746	.503	72.91
4289	124.00 - 124.50	46.00 - 46.50	3.885	.155	69.97	2.821	.411	82.38
4290	124.00 - 124.50	46.50 - 47.00	3.898	.136	30.54	2.940	.316	95.88
4291	124.00 - 124.50	47.00 - 47.50	3.945	.144	30.52	2.796	.026	76.99
4292	124.00 - 124.50	47.50 - 48.00	4.008	.172	37.79	3.019	.103	68.62
4293	124.00 - 124.50	48.00 - 48.50	4.065	.150	32.74	3.019	.103	50.94
4294	124.00 - 124.50	48.50 - 49.00	3.953	.155	43.14	2.986	.137	60.00
4295	124.00 - 124.50	49.00 - 49.50	3.901	.156	58.34	2.884	.114	72.95
4296	124.00 - 124.50	49.50 - 50.00	3.776	.217	66.89	2.839	.206	76.67
4297	124.50 - 125.00	38.00 - 38.50	5.079	.275	153.48	4.710	.252	136.65
4298	124.50 - 125.00	38.50 - 39.00	5.072	.274	143.47	4.784	.241	118.67
4299	124.50 - 125.00	39.00 - 39.50	5.072	.275	127.45	4.829	.227	97.03
4300	124.50 - 125.00	39.50 - 40.00	5.065	.277	110.33	4.886	.198	65.38
4301	124.50 - 125.00	40.00 - 40.50	5.027	.305	55.09	4.904	.198	25.56
4302	124.50 - 125.00	40.50 - 41.00	4.978	.328	34.55	4.958	.196	42.99
4303	124.50 - 125.00	41.00 - 41.50	4.857	.332	48.42	4.958	.195	60.98
4304	124.50 - 125.00	41.50 - 42.00	4.672	.282	76.22	4.954	.193	91.89
4305	124.50 - 125.00	42.00 - 42.50	4.142	.491	74.45	4.278	.206	64.04

SEISMIC MAP OF CONTINENTAL U.S.

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4306	124.50 - 125.00	42.50 - 43.00	2.783	.490	44.07	4.237	.209	53.86
4307	124.50 - 125.00	43.00 - 43.50	2.783	.490	74.25	4.151	.216	71.89
4308	124.50 - 125.00	43.50 - 44.00	2.423	.000	101.31	3.963	.198	75.30
4309	124.50 - 125.00	44.00 - 44.50	3.262	.238	91.82	3.637	.193	80.21
4310	124.50 - 125.00	44.50 - 45.00	3.262	.238	71.84	3.199	.123	93.67
4311	124.50 - 125.00	45.00 - 45.50	3.262	.238	63.47	2.296	.225	80.66
4312	124.50 - 125.00	45.50 - 46.00	3.373	.252	74.07	2.296	.225	72.91
4313	124.50 - 125.00	46.00 - 46.50	3.577	.231	69.51	2.296	.225	80.66
4314	124.50 - 125.00	46.50 - 47.00	3.557	.203	46.66	2.296	.225	100.38
4315	124.50 - 125.00	47.00 - 47.50	3.667	.256	46.22	2.621	.255	90.44
4316	124.50 - 125.00	47.50 - 48.00	3.758	.316	48.63	2.981	.245	80.93
4317	124.50 - 125.00	48.00 - 48.50	3.740	.303	30.69	2.981	.245	67.19
4318	124.50 - 125.00	48.50 - 49.00	3.731	.269	44.31	2.981	.245	69.04
4319	124.50 - 125.00	49.00 - 49.50	3.679	.266	52.29	2.981	.245	82.54
4320	124.50 - 125.00	49.50 - 50.00	3.554	.307	37.60	2.939	.298	85.62
4321	125.00 - 125.50	40.00 - 40.50	5.015	.312	64.41	4.902	.199	31.79
4322	125.00 - 125.50	40.50 - 41.00	4.967	.333	44.84	4.959	.197	37.22
4323	125.00 - 125.50	41.00 - 41.50	4.843	.339	58.68	4.980	.202	60.03
4324	125.00 - 125.50	41.50 - 42.00	4.653	.283	86.61	4.978	.200	70.09
4325	125.00 - 125.50	42.00 - 42.50	4.117	.504	93.99	4.437	.210	40.26
4326	125.00 - 125.50	42.50 - 43.00	2.783	.490	62.44	4.453	.203	60.62
4327	125.00 - 125.50	43.00 - 43.50	2.783	.490	86.43	4.380	.202	51.27
4328	125.00 - 125.50	43.50 - 44.00	.000	.000	.00	4.279	.200	57.08
4329	125.00 - 125.50	44.00 - 44.50	2.723	.300	100.85	4.092	.200	75.33
4330	125.00 - 125.50	44.50 - 45.00	2.723	.300	81.24	3.816	.269	93.36
4331	125.00 - 125.50	45.00 - 45.50	2.723	.300	73.55	2.296	.225	60.07
4332	125.00 - 125.50	45.50 - 46.00	3.024	.300	82.69	2.296	.225	49.17
4333	125.00 - 125.50	46.00 - 46.50	3.200	.300	75.22	2.296	.225	60.07
4334	125.00 - 125.50	46.50 - 47.00	3.112	.212	55.65	2.296	.225	84.73
4335	125.00 - 125.50	47.00 - 47.50	3.351	.149	60.48	2.881	.298	89.81
4336	125.00 - 125.50	47.50 - 48.00	3.612	.189	65.72	3.040	.318	70.46
4337	125.00 - 125.50	48.00 - 48.50	3.549	.172	47.73	3.040	.318	56.52
4338	125.00 - 125.50	48.50 - 49.00	3.613	.244	23.78	3.040	.318	57.83
4339	125.00 - 125.50	49.00 - 49.50	3.601	.255	47.01	3.040	.318	74.92
4340	125.00 - 125.50	49.50 - 50.00	3.528	.300	15.69	2.822	.367	82.75

* SEISMIC MAP OF CONTINENTAL U.S. *

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
4341	125.50 - 126.00	40.00 - 40.50	4.978	.344	62.30	4.876	.203	31.15
4342	125.50 - 126.00	40.50 - 41.00	4.957	.344	75.32	4.950	.199	45.65
4343	125.50 - 126.00	41.00 - 41.50	4.836	.346	59.87	4.988	.207	52.46
4344	125.50 - 126.00	41.50 - 42.00	4.642	.290	98.90	4.994	.204	50.49
4345	125.50 - 126.00	42.00 - 42.50	4.117	.504	110.76	4.522	.227	34.66
4346	125.50 - 126.00	42.50 - 43.00	2.783	.490	84.61	4.573	.243	47.61
4347	125.50 - 126.00	43.00 - 43.50	2.783	.490	103.59	4.492	.227	37.01
4348	125.50 - 126.00	43.50 - 44.00	.000	.000	.00	4.420	.220	48.22
4349	125.50 - 126.00	44.00 - 44.50	.000	.000	.00	4.316	.182	66.82
4350	125.50 - 126.00	44.50 - 45.00	.000	.000	.00	4.130	.199	87.75
4351	125.50 - 126.00	45.00 - 45.50	.000	.000	.00	2.987	.184	65.23
4352	125.50 - 126.00	45.50 - 46.00	2.723	.300	99.45	2.839	.206	40.98
4353	125.50 - 126.00	46.00 - 46.50	3.024	.300	87.52	2.839	.203	60.26
4354	125.50 - 126.00	46.50 - 47.00	3.112	.212	77.53	2.881	.147	87.12
4355	125.50 - 126.00	47.00 - 47.50	3.311	.189	79.41	2.881	.298	77.03
4356	125.50 - 126.00	47.50 - 48.00	3.413	.212	75.27	3.114	.277	57.54
4357	125.50 - 126.00	48.00 - 48.50	3.311	.189	56.98	3.114	.277	37.10
4358	125.50 - 126.00	48.50 - 49.00	3.492	.300	46.93	3.114	.277	37.88
4359	125.50 - 126.00	49.00 - 49.50	3.471	.325	50.29	3.081	.318	60.10
4360	125.50 - 126.00	49.50 - 50.00	3.355	.414	31.07	2.939	.298	85.31

SEISMICITY FOR ALASKA

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1	130.00 - 130.50	52.00 - 52.50	2.762	.490	82.01	4.075	.261	61.04
2	130.00 - 130.50	52.50 - 53.00	2.762	.490	112.59	4.069	.267	86.68
3	130.00 - 130.50	53.00 - 53.50	2.762	.490	144.95	4.069	.267	94.33
4	130.00 - 130.50	53.50 - 54.00	2.762	.490	178.10	4.019	.270	125.60
5	130.00 - 130.50	54.00 - 54.50	2.762	.490	211.69	3.949	.234	150.77
6	130.00 - 130.50	54.50 - 55.00	.000	.000	.00	4.052	.307	188.49
7	130.00 - 130.50	55.00 - 55.50	2.502	.000	263.90	3.800	.274	136.67
8	130.00 - 130.50	55.50 - 56.00	2.502	.000	237.81	3.769	.296	199.26
9	130.00 - 130.50	56.00 - 56.50	2.803	.000	237.56	3.696	.341	206.32
10	130.00 - 130.50	56.50 - 57.00	2.803	.000	215.13	3.659	.378	215.28
11	130.00 - 130.50	57.00 - 57.50	2.803	.000	196.58	3.638	.400	227.27
12	130.00 - 130.50	57.50 - 58.00	2.803	.000	182.99	3.501	.445	229.97
13	130.00 - 130.50	58.00 - 58.50	2.803	.000	175.14	3.638	.430	247.72
14	130.00 - 130.50	58.50 - 59.00	2.803	.000	173.27	3.680	.387	265.36
15	130.00 - 130.50	59.00 - 59.50	2.803	.000	177.15	3.688	.376	275.83
16	130.00 - 130.50	59.50 - 60.00	2.803	.000	186.43	3.183	.187	210.35
17	130.50 - 131.00	52.00 - 52.50	2.762	.490	72.99	4.085	.258	45.46
18	130.50 - 131.00	52.50 - 53.00	2.762	.490	106.20	4.080	.264	74.01
19	130.50 - 131.00	53.00 - 53.50	2.762	.490	140.04	4.166	.322	60.61
20	130.50 - 131.00	53.50 - 54.00	2.762	.490	174.13	4.136	.324	125.26
21	130.50 - 131.00	54.00 - 54.50	2.762	.490	208.36	4.089	.304	154.30
22	130.50 - 131.00	54.50 - 55.00	.000	.000	.00	4.109	.302	180.46
23	130.50 - 131.00	55.00 - 55.50	2.502	.000	253.06	3.896	.271	177.91
24	130.50 - 131.00	55.50 - 56.00	2.502	.000	225.72	3.870	.290	186.67
25	130.50 - 131.00	56.00 - 56.50	2.803	.000	224.48	3.813	.327	190.82
26	130.50 - 131.00	56.50 - 57.00	2.803	.000	200.56	3.787	.355	198.17
27	130.50 - 131.00	57.00 - 57.50	2.803	.000	180.57	3.772	.371	209.61
28	130.50 - 131.00	57.50 - 58.00	2.803	.000	165.88	3.684	.396	218.45
29	130.50 - 131.00	58.00 - 58.50	3.201	.000	185.09	3.743	.355	233.44
30	130.50 - 131.00	58.50 - 59.00	3.201	.000	180.63	3.772	.326	251.19
31	130.50 - 131.00	59.00 - 59.50	3.201	.000	181.29	3.777	.317	264.45
32	130.50 - 131.00	59.50 - 60.00	3.201	.000	186.55	3.326	.150	216.57
33	131.00 - 131.50	52.00 - 52.50	2.762	.490	69.72	4.085	.258	37.93
34	131.00 - 131.50	52.50 - 53.00	2.762	.490	103.98	4.080	.264	54.17
35	131.00 - 131.50	53.00 - 53.50	2.762	.490	138.36	4.209	.318	92.60

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
36	131.00 - 131.50	53.50 - 54.00	2.762	.490	172.79	4.183	.319	121.90
37	131.00 - 131.50	54.00 - 54.50	2.762	.490	207.24	4.140	.301	146.91
38	131.00 - 131.50	54.50 - 55.00	.000	.000	.00	4.135	.288	169.92
39	131.00 - 131.50	55.00 - 55.50	2.803	.000	257.66	3.936	.252	165.78
40	131.00 - 131.50	55.50 - 56.00	2.803	.000	230.29	3.914	.269	172.71
41	131.00 - 131.50	56.00 - 56.50	2.979	.000	217.05	3.876	.287	176.26
42	131.00 - 131.50	56.50 - 57.00	3.104	.000	205.80	3.856	.308	182.27
43	131.00 - 131.50	57.00 - 57.50	3.201	.000	194.88	3.845	.320	192.91
44	131.00 - 131.50	57.50 - 58.00	3.201	.000	177.85	3.776	.333	202.70
45	131.00 - 131.50	58.00 - 58.50	3.280	.000	171.99	3.807	.291	213.85
46	131.00 - 131.50	58.50 - 59.00	3.280	.000	168.77	3.827	.272	227.59
47	131.00 - 131.50	59.00 - 59.50	3.280	.000	170.79	3.831	.265	238.85
48	131.00 - 131.50	59.50 - 60.00	3.280	.000	177.42	3.350	.151	198.33
49	131.50 - 132.00	52.00 - 52.50	2.762	.490	72.99	4.085	.258	47.83
50	131.50 - 132.00	52.50 - 53.00	2.762	.490	106.20	4.080	.264	47.11
51	131.50 - 132.00	53.00 - 53.50	2.762	.490	140.04	4.218	.314	88.61
52	131.50 - 132.00	53.50 - 54.00	2.762	.490	174.13	4.197	.310	103.09
53	131.50 - 132.00	54.00 - 54.50	2.762	.490	208.36	4.165	.288	135.17
54	131.50 - 132.00	54.50 - 55.00	2.502	.000	277.20	4.135	.288	156.55
55	131.50 - 132.00	55.00 - 55.50	2.979	.000	249.15	3.936	.252	151.17
56	131.50 - 132.00	55.50 - 56.00	2.979	.000	222.52	3.922	.260	157.62
57	131.50 - 132.00	56.00 - 56.50	3.104	.000	206.36	3.918	.245	162.61
58	131.50 - 132.00	56.50 - 57.00	3.201	.000	192.76	3.903	.260	167.72
59	131.50 - 132.00	57.00 - 57.50	3.280	.000	180.22	3.894	.269	177.41
60	131.50 - 132.00	57.50 - 58.00	3.280	.000	163.55	3.833	.275	135.82
61	131.50 - 132.00	58.00 - 58.50	4.052	.866	213.30	3.849	.250	196.49
62	131.50 - 132.00	58.50 - 59.00	4.052	.866	210.51	3.864	.236	208.30
63	131.50 - 132.00	59.00 - 59.50	4.052	.866	214.38	3.868	.231	218.49
64	131.50 - 132.00	59.50 - 60.00	4.052	.866	224.32	3.439	.185	173.82
65	132.00 - 132.50	52.00 - 52.50	2.762	.490	82.01	4.085	.258	57.50
66	132.00 - 132.50	52.50 - 53.00	2.762	.490	112.59	4.080	.264	41.60
67	132.00 - 132.50	53.00 - 53.50	2.762	.490	144.95	4.218	.314	50.32
68	132.00 - 132.50	53.50 - 54.00	2.762	.490	178.10	4.197	.310	52.67
69	132.00 - 132.50	54.00 - 54.50	2.762	.490	211.69	4.165	.288	121.17
70	132.00 - 132.50	54.50 - 55.00	2.953	.149	266.01	4.135	.288	141.71

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
71	132.0 - 132.5	55.00 - 55.50	3.103	.001	220.70	3.936	.252	136.79
72	132.0 - 132.5	55.50 - 56.00	4.019	.895	302.23	3.941	.239	143.73
73	132.0 - 132.5	56.00 - 56.50	4.032	.883	271.31	3.942	.220	146.69
74	132.0 - 132.5	56.50 - 57.00	4.043	.873	244.33	3.929	.233	151.06
75	132.0 - 132.5	57.00 - 57.50	4.052	.866	221.09	3.929	.233	151.65
76	132.0 - 132.5	57.50 - 58.00	4.052	.866	202.66	3.864	.242	159.62
77	132.0 - 132.5	58.00 - 58.50	4.060	.860	191.43	3.864	.231	180.85
78	132.0 - 132.5	58.50 - 59.00	4.060	.860	188.69	3.882	.219	192.25
79	132.0 - 132.5	59.00 - 59.50	4.060	.860	192.97	3.885	.214	201.66
80	132.0 - 132.5	59.50 - 60.00	4.060	.860	203.51	3.479	.201	160.81
81	132.5 - 133.0	52.00 - 52.50	2.762	.490	95.17	4.085	.258	32.83
82	132.5 - 133.0	52.50 - 53.00	2.762	.490	122.51	4.080	.264	43.42
83	132.5 - 133.0	53.00 - 53.50	2.762	.490	152.78	4.218	.314	91.49
84	132.5 - 133.0	53.50 - 54.00	2.762	.490	184.54	4.197	.310	97.56
85	132.5 - 133.0	54.00 - 54.50	2.762	.490	217.13	4.165	.288	104.78
86	132.5 - 133.0	54.50 - 55.00	2.953	.149	254.72	4.135	.288	123.98
87	132.5 - 133.0	55.00 - 55.50	3.103	.001	210.91	3.936	.252	122.94
88	132.5 - 133.0	55.50 - 56.00	4.019	.895	288.41	3.941	.239	127.75
89	132.5 - 133.0	56.00 - 56.50	4.043	.873	256.28	3.958	.204	129.53
90	132.5 - 133.0	56.50 - 57.00	4.052	.866	227.52	3.945	.215	133.46
91	132.5 - 133.0	57.00 - 57.50	4.060	.860	202.41	3.945	.215	144.98
92	132.5 - 133.0	57.50 - 58.00	4.060	.860	181.91	3.887	.223	154.35
93	132.5 - 133.0	58.00 - 58.50	4.067	.855	169.72	3.882	.219	166.35
94	132.5 - 133.0	58.50 - 59.00	4.067	.855	167.44	3.889	.214	177.18
95	132.5 - 133.0	59.00 - 59.50	4.067	.855	172.21	3.892	.210	186.57
96	132.5 - 133.0	59.50 - 60.00	4.067	.855	183.24	3.479	.201	147.34
97	133.0 - 133.5	52.00 - 52.50	2.762	.490	111.00	4.085	.258	100.99
98	133.0 - 133.5	52.50 - 53.00	2.762	.490	135.18	4.080	.264	31.99
99	133.0 - 133.5	53.00 - 53.50	2.762	.490	163.11	4.218	.314	112.40
100	133.0 - 133.5	53.50 - 54.00	2.762	.490	193.18	4.197	.310	102.93
101	133.0 - 133.5	54.00 - 54.50	2.762	.490	224.52	4.165	.288	59.46
102	133.0 - 133.5	54.50 - 55.00	2.953	.149	244.22	4.140	.283	104.81
103	133.0 - 133.5	55.00 - 55.50	3.103	.001	201.92	3.943	.245	110.79
104	133.0 - 133.5	55.50 - 56.00	4.019	.895	275.50	3.954	.225	112.57
105	133.0 - 133.5	56.00 - 56.50	4.043	.873	242.24	3.972	.193	110.71

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
106	133.00 - 133.50	56.50 - 57.00	4.052	.866	211.93	3.960	.200	114.93
107	133.00 - 133.50	57.00 - 57.50	4.067	.855	185.15	3.960	.200	127.97
108	133.00 - 133.50	57.50 - 58.00	4.067	.855	161.36	3.904	.207	139.72
109	133.00 - 133.50	58.00 - 58.50	4.067	.855	146.45	3.901	.212	153.93
110	133.00 - 133.50	58.50 - 59.00	4.067	.855	146.02	3.907	.207	163.65
111	133.00 - 133.50	59.00 - 59.50	4.067	.855	151.71	3.910	.202	171.78
112	133.00 - 133.50	59.50 - 60.00	4.067	.855	163.85	3.552	.158	141.03
113	133.50 - 134.00	52.00 - 52.50	2.762	.490	128.53	4.085	.258	122.02
114	133.50 - 134.00	52.50 - 53.00	2.762	.490	149.90	4.080	.264	114.28
115	133.50 - 134.00	53.00 - 53.50	2.762	.490	175.50	4.223	.309	129.30
116	133.50 - 134.00	53.50 - 54.00	2.762	.490	203.75	4.202	.305	99.22
117	133.50 - 134.00	54.00 - 54.50	2.762	.490	233.68	4.169	.283	33.33
118	133.50 - 134.00	54.50 - 55.00	2.953	.149	234.63	4.140	.283	91.94
119	133.50 - 134.00	55.00 - 55.50	3.103	.001	193.78	3.943	.245	99.84
120	133.50 - 134.00	55.50 - 56.00	4.019	.895	263.65	3.954	.225	95.87
121	133.50 - 134.00	56.00 - 56.50	4.043	.873	229.19	3.985	.186	90.26
122	133.50 - 134.00	56.50 - 57.00	4.052	.866	197.31	3.974	.196	95.92
123	133.50 - 134.00	57.00 - 57.50	4.067	.855	168.53	3.974	.196	110.42
124	133.50 - 134.00	57.50 - 58.00	4.067	.855	140.16	3.920	.201	126.33
125	133.50 - 134.00	58.00 - 58.50	4.074	.850	120.07	3.919	.193	141.22
126	133.50 - 134.00	58.50 - 59.00	4.074	.850	125.09	3.925	.189	149.16
127	133.50 - 134.00	59.00 - 59.50	4.074	.850	131.27	3.927	.184	155.36
128	133.50 - 134.00	59.50 - 60.00	4.074	.850	145.02	3.591	.165	128.57
129	134.00 - 134.50	55.00 - 55.50	3.152	.049	182.22	3.949	.234	90.70
130	134.00 - 134.50	55.50 - 56.00	4.032	.883	250.79	3.973	.204	80.34
131	134.00 - 134.50	56.00 - 56.50	4.052	.866	215.70	4.000	.170	67.21
132	134.00 - 134.50	56.50 - 57.00	4.060	.860	183.17	3.990	.178	76.49
133	134.00 - 134.50	57.00 - 57.50	4.074	.850	153.26	3.990	.178	98.13
134	134.00 - 134.50	57.50 - 58.00	4.074	.850	120.46	3.937	.183	113.54
135	134.00 - 134.50	58.00 - 58.50	4.074	.850	83.59	3.937	.173	130.11
136	134.00 - 134.50	58.50 - 59.00	4.074	.850	104.71	3.943	.170	134.93
137	134.00 - 134.50	59.00 - 59.50	4.074	.850	108.05	3.945	.166	138.41
138	134.00 - 134.50	59.50 - 60.00	4.074	.850	125.37	3.629	.174	115.63
139	134.50 - 135.00	55.00 - 55.50	3.152	.049	174.95	3.956	.227	83.37
140	134.50 - 135.00	55.50 - 56.00	4.032	.883	240.84	3.978	.198	65.16

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
141	134.50 - 135.00	56.00 - 56.50	4.052	.866	204.73	4.005	.166	40.61
142	134.50 - 135.00	56.50 - 57.00	4.060	.860	170.72	4.000	.170	36.57
143	134.50 - 135.00	57.00 - 57.50	4.074	.850	139.51	4.000	.170	38.49
144	134.50 - 135.00	57.50 - 58.00	4.074	.850	105.82	3.951	.171	104.20
145	134.50 - 135.00	58.00 - 58.50	4.212	.883	53.61	3.943	.170	119.46
146	134.50 - 135.00	58.50 - 59.00	4.212	.883	100.45	3.963	.161	120.90
147	134.50 - 135.00	59.00 - 59.50	4.212	.883	88.03	3.965	.157	120.64
148	134.50 - 135.00	59.50 - 60.00	4.212	.883	118.85	3.692	.148	105.90
149	135.00 - 135.50	55.00 - 55.50	3.152	.049	168.49	3.956	.227	30.41
150	135.00 - 135.50	55.50 - 56.00	4.032	.883	232.16	3.978	.198	55.99
151	135.00 - 135.50	56.00 - 56.50	4.052	.866	195.06	4.005	.166	19.80
152	135.00 - 135.50	56.50 - 57.00	4.067	.855	159.97	4.000	.170	36.69
153	135.00 - 135.50	57.00 - 57.50	4.212	.883	142.75	4.000	.170	72.44
154	135.00 - 135.50	57.50 - 58.00	4.212	.883	109.46	3.951	.171	97.98
155	135.00 - 135.50	58.00 - 58.50	4.212	.883	79.85	4.204	.265	135.43
156	135.00 - 135.50	58.50 - 59.00	4.212	.883	87.51	4.224	.250	128.10
157	135.00 - 135.50	59.00 - 59.50	4.212	.883	52.10	4.225	.247	120.56
158	135.00 - 135.50	59.50 - 60.00	4.212	.883	100.83	4.071	.187	120.49
159	135.50 - 136.00	55.00 - 55.50	3.152	.049	162.83	3.956	.227	84.62
160	135.50 - 136.00	55.50 - 56.00	4.032	.883	224.01	3.978	.198	56.03
161	135.50 - 136.00	56.00 - 56.50	4.052	.866	186.82	4.005	.166	21.10
162	135.50 - 136.00	56.50 - 57.00	4.067	.855	149.95	4.005	.166	47.84
163	135.50 - 136.00	57.00 - 57.50	4.212	.883	128.53	4.124	.202	73.81
164	135.50 - 136.00	57.50 - 58.00	4.212	.883	95.66	4.208	.268	116.58
165	135.50 - 136.00	58.00 - 58.50	4.212	.883	71.82	4.233	.242	125.95
166	135.50 - 136.00	58.50 - 59.00	4.212	.883	73.51	4.254	.226	108.48
167	135.50 - 136.00	59.00 - 59.50	4.212	.883	72.33	4.263	.221	90.04
168	135.50 - 136.00	59.50 - 60.00	4.212	.883	79.41	4.118	.161	104.96
169	136.00 - 136.50	55.00 - 55.50	3.152	.049	157.94	3.946	.239	92.43
170	136.00 - 136.50	55.50 - 56.00	4.032	.883	218.82	3.973	.204	63.90
171	136.00 - 136.50	56.00 - 56.50	4.052	.866	180.20	4.000	.170	32.46
172	136.00 - 136.50	56.50 - 57.00	4.067	.855	141.71	4.007	.162	43.65
173	136.00 - 136.50	57.00 - 57.50	4.212	.883	114.06	4.147	.191	46.28
174	136.00 - 136.50	57.50 - 58.00	4.212	.883	74.54	4.235	.247	114.89
175	136.00 - 136.50	58.00 - 58.50	4.212	.883	46.52	4.236	.237	114.22

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
176	136.00 - 136.50	58.50 - 59.00	4.212	.883	54.69	4.257	.222	33.34
177	136.00 - 136.50	59.00 - 59.50	4.212	.883	68.57	4.266	.217	53.19
178	136.00 - 136.50	59.50 - 60.00	4.212	.883	50.93	4.121	.157	39.11
179	136.00 - 136.50	60.00 - 60.50	4.207	.887	52.91	4.108	.160	111.05
180	136.00 - 136.50	60.50 - 61.00	4.207	.887	127.88	4.096	.165	128.76
181	136.50 - 137.00	55.00 - 55.50	3.152	.049	153.77	3.929	.249	101.84
182	136.50 - 137.00	55.50 - 56.00	4.032	.883	214.08	3.970	.208	77.94
183	136.50 - 137.00	56.00 - 56.50	4.052	.866	175.16	4.000	.170	58.23
184	136.50 - 137.00	56.50 - 57.00	4.067	.855	136.05	4.007	.162	66.12
185	136.50 - 137.00	57.00 - 57.50	4.212	.883	102.78	4.148	.188	81.52
186	136.50 - 137.00	57.50 - 58.00	4.212	.883	45.94	4.237	.245	118.00
187	136.50 - 137.00	58.00 - 58.50	4.322	.811	59.76	4.267	.221	107.29
188	136.50 - 137.00	58.50 - 59.00	4.322	.811	35.80	4.286	.208	55.77
189	136.50 - 137.00	59.00 - 59.50	4.322	.811	64.57	4.294	.204	38.23
190	136.50 - 137.00	59.50 - 60.00	4.322	.811	82.19	4.155	.149	81.99
191	136.50 - 137.00	60.00 - 60.50	4.317	.816	92.38	4.143	.151	90.34
192	136.50 - 137.00	60.50 - 61.00	4.317	.816	139.83	4.130	.156	119.06
193	137.00 - 137.50	55.00 - 55.50	3.152	.049	150.25	3.917	.263	113.14
194	137.00 - 137.50	55.50 - 56.00	4.032	.883	210.33	3.964	.214	93.53
195	137.00 - 137.50	56.00 - 56.50	4.052	.866	171.19	4.000	.170	81.00
196	137.00 - 137.50	56.50 - 57.00	4.067	.855	133.33	4.007	.162	85.81
197	137.00 - 137.50	57.00 - 57.50	4.322	.811	111.82	4.166	.177	108.11
198	137.00 - 137.50	57.50 - 58.00	4.322	.811	43.18	4.267	.229	126.30
199	137.00 - 137.50	58.00 - 58.50	4.322	.811	57.80	4.422	.238	116.96
200	137.00 - 137.50	58.50 - 59.00	4.322	.811	17.77	4.435	.227	52.56
201	137.00 - 137.50	59.00 - 59.50	4.322	.811	56.46	4.441	.224	56.31
202	137.00 - 137.50	59.50 - 60.00	4.322	.811	90.98	4.352	.186	93.66
203	137.00 - 137.50	60.00 - 60.50	4.317	.816	106.68	4.344	.189	70.75
204	137.00 - 137.50	60.50 - 61.00	4.317	.816	137.93	4.335	.194	127.00
205	137.50 - 138.00	55.00 - 55.50	3.152	.049	147.43	3.883	.287	122.82
206	137.50 - 138.00	55.50 - 56.00	4.032	.883	207.18	3.966	.240	106.34
207	137.50 - 138.00	56.00 - 56.50	4.052	.866	166.66	4.049	.195	88.01
208	137.50 - 138.00	56.50 - 57.00	4.067	.855	131.70	4.239	.227	121.68
209	137.50 - 138.00	57.00 - 57.50	4.322	.811	120.36	4.349	.219	139.61
210	137.50 - 138.00	57.50 - 58.00	4.322	.811	75.66	4.421	.244	144.38

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
211	137.50 - 138.00	58.00 - 58.50	4.322	.811	65.01	4.473	.231	122.57
212	137.50 - 138.00	58.50 - 59.00	4.322	.811	35.83	4.485	.222	81.41
213	137.50 - 138.00	59.00 - 59.50	4.322	.811	43.40	4.490	.219	53.75
214	137.50 - 138.00	59.50 - 60.00	4.322	.811	92.03	4.411	.184	97.40
215	137.50 - 138.00	60.00 - 60.50	4.317	.816	91.15	4.404	.186	102.25
216	137.50 - 138.00	60.50 - 61.00	4.317	.816	130.66	4.396	.190	123.00
217	138.00 - 138.50	55.00 - 55.50	3.152	.049	145.57	3.864	.294	133.92
218	138.00 - 138.50	55.50 - 56.00	4.032	.883	204.50	3.966	.240	115.42
219	138.00 - 138.50	56.00 - 56.50	4.052	.866	153.68	4.094	.198	58.75
220	138.00 - 138.50	56.50 - 57.00	4.067	.855	123.80	4.291	.229	134.74
221	138.00 - 138.50	57.00 - 57.50	4.322	.811	132.13	4.395	.220	147.23
222	138.00 - 138.50	57.50 - 58.00	4.322	.811	103.33	4.466	.240	148.18
223	138.00 - 138.50	58.00 - 58.50	4.322	.811	80.84	4.539	.223	126.89
224	138.00 - 138.50	58.50 - 59.00	4.322	.811	62.14	4.549	.215	76.36
225	138.00 - 138.50	59.00 - 59.50	4.322	.811	71.31	4.553	.213	72.03
226	138.00 - 138.50	59.50 - 60.00	4.322	.811	93.96	4.484	.183	102.13
227	138.00 - 138.50	60.00 - 60.50	4.317	.816	57.99	4.479	.185	111.10
228	138.00 - 138.50	60.50 - 61.00	4.317	.816	121.91	4.472	.188	117.56
229	138.00 - 138.50	61.00 - 61.50	4.317	.816	162.28	4.543	.184	134.10
230	138.00 - 138.50	61.50 - 62.00	4.304	.829	200.53	4.544	.183	150.96
231	138.00 - 138.50	62.00 - 62.50	4.039	.663	211.05	4.539	.191	173.02
232	138.00 - 138.50	62.50 - 63.00	4.023	.679	249.90	4.521	.212	197.66
233	138.00 - 138.50	63.00 - 63.50	4.000	.704	290.66	4.312	.186	195.67
234	138.00 - 138.50	63.50 - 64.00	3.041	.061	215.03	4.220	.163	201.83
235	138.00 - 138.50	64.00 - 64.50	2.603	.000	225.84	3.846	.151	158.30
236	138.00 - 138.50	64.50 - 65.00	2.603	.000	219.88	3.805	.147	144.92
237	138.00 - 138.50	65.00 - 65.50	2.603	.000	238.13	3.768	.158	130.09
238	138.00 - 138.50	65.50 - 66.00	2.603	.000	259.70	3.748	.158	116.34
239	138.00 - 138.50	66.00 - 66.50	2.603	.000	283.83	3.749	.165	103.76
240	138.00 - 138.50	66.50 - 67.00	.000	.000	.00	3.740	.171	92.51
241	138.00 - 138.50	67.00 - 67.50	.000	.000	.00	3.774	.165	90.32
242	138.00 - 138.50	67.50 - 68.00	.000	.000	.00	3.804	.164	90.08
243	138.00 - 138.50	68.00 - 68.50	.000	.000	.00	3.797	.167	112.02
244	138.00 - 138.50	68.50 - 69.00	.000	.000	.00	3.679	.201	128.08
245	138.00 - 138.50	69.00 - 69.50	.000	.000	.00	3.598	.177	146.29

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
246	138.00 - 138.50	69.50 - 70.00	.000	.000	.00	3.581	.183	159.48
247	138.00 - 138.50	70.00 - 70.50	.000	.000	.00	3.440	.181	154.70
248	138.00 - 138.50	70.50 - 71.00	.000	.000	.00	3.345	.165	156.01
249	138.50 - 139.00	55.00 - 55.50	3.152	.049	145.17	3.864	.294	147.93
250	138.50 - 139.00	55.50 - 56.00	4.032	.883	203.19	3.966	.240	130.21
251	138.50 - 139.00	56.00 - 56.50	4.052	.866	146.16	4.106	.193	106.12
252	138.50 - 139.00	56.50 - 57.00	4.067	.855	91.95	4.327	.232	145.11
253	138.50 - 139.00	57.00 - 57.50	4.322	.811	138.81	4.431	.220	135.22
254	138.50 - 139.00	57.50 - 58.00	4.322	.811	122.00	4.529	.232	150.53
255	138.50 - 139.00	58.00 - 58.50	4.354	.777	103.11	4.600	.210	126.46
256	138.50 - 139.00	58.50 - 59.00	4.354	.777	89.01	4.609	.204	95.47
257	138.50 - 139.00	59.00 - 59.50	4.354	.777	93.40	4.612	.202	69.39
258	138.50 - 139.00	59.50 - 60.00	4.354	.777	98.08	4.549	.180	102.59
259	138.50 - 139.00	60.00 - 60.50	4.354	.777	85.63	4.545	.181	105.68
260	138.50 - 139.00	60.50 - 61.00	4.354	.777	117.77	4.543	.184	107.74
261	138.50 - 139.00	61.00 - 61.50	4.322	.811	154.59	4.678	.204	127.99
262	138.50 - 139.00	61.50 - 62.00	4.311	.822	194.63	4.678	.205	147.15
263	138.50 - 139.00	62.00 - 62.50	4.046	.657	202.78	4.674	.211	172.60
264	138.50 - 139.00	62.50 - 63.00	4.031	.670	239.16	4.649	.213	200.05
265	138.50 - 139.00	63.00 - 63.50	4.013	.690	276.69	4.353	.166	192.96
266	138.50 - 139.00	63.50 - 64.00	3.041	.061	200.64	4.312	.174	210.55
267	138.50 - 139.00	64.00 - 64.50	2.803	.000	191.28	3.875	.151	165.17
268	138.50 - 139.00	64.50 - 65.00	2.603	.000	206.32	3.814	.140	153.71
269	138.50 - 139.00	65.00 - 65.50	2.603	.000	225.68	3.779	.148	140.98
270	138.50 - 139.00	65.50 - 66.00	2.803	.000	248.33	3.759	.147	128.10
271	138.50 - 139.00	66.00 - 66.50	2.603	.000	273.47	3.757	.160	116.52
272	138.50 - 139.00	66.50 - 67.00	.000	.000	.00	3.766	.170	108.61
273	138.50 - 139.00	67.00 - 67.50	.000	.000	.00	3.797	.167	107.12
274	138.50 - 139.00	67.50 - 68.00	.000	.000	.00	3.804	.164	109.05
275	138.50 - 139.00	68.00 - 68.50	.000	.000	.00	3.797	.167	125.46
276	138.50 - 139.00	68.50 - 69.00	.000	.000	.00	3.679	.201	135.05
277	138.50 - 139.00	69.00 - 69.50	.000	.000	.00	3.615	.172	148.30
278	138.50 - 139.00	69.50 - 70.00	.000	.000	.00	3.598	.177	156.13
279	138.50 - 139.00	70.00 - 70.50	.000	.000	.00	3.463	.175	148.39
280	138.50 - 139.00	70.50 - 71.00	.000	.000	.00	3.373	.160	148.68

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
281	139.00 - 139.50	55.00 - 55.50	3.152	.049	146.92	3.804	.295	157.60
282	139.00 - 139.50	55.50 - 56.00	4.032	.883	205.48	3.920	.235	144.80
283	139.00 - 139.50	56.00 - 56.50	4.052	.866	139.66	4.081	.179	138.56
284	139.00 - 139.50	56.50 - 57.00	4.067	.855	48.56	4.393	.218	155.39
285	139.00 - 139.50	57.00 - 57.50	4.322	.811	143.62	4.485	.209	93.71
286	139.00 - 139.50	57.50 - 58.00	4.354	.777	142.46	4.592	.217	151.24
287	139.00 - 139.50	58.00 - 58.50	4.354	.777	122.66	4.729	.210	110.13
288	139.00 - 139.50	58.50 - 59.00	4.354	.777	109.91	4.734	.206	77.06
289	139.00 - 139.50	59.00 - 59.50	4.354	.777	105.28	4.737	.205	106.34
290	139.00 - 139.50	59.50 - 60.00	4.354	.777	91.72	4.685	.203	101.19
291	139.00 - 139.50	60.00 - 60.50	4.358	.773	77.99	4.682	.204	100.31
292	139.00 - 139.50	60.50 - 61.00	4.358	.773	105.39	4.680	.205	98.24
293	139.00 - 139.50	61.00 - 61.50	4.322	.811	146.61	4.778	.197	112.49
294	139.00 - 139.50	61.50 - 62.00	4.311	.822	189.28	4.778	.198	137.53
295	139.00 - 139.50	62.00 - 62.50	4.046	.657	196.71	4.775	.202	167.73
296	139.00 - 139.50	62.50 - 63.00	4.031	.670	232.27	4.731	.196	196.36
297	139.00 - 139.50	63.00 - 63.50	4.013	.690	268.18	4.449	.161	195.27
298	139.00 - 139.50	63.50 - 64.00	3.041	.061	186.15	4.357	.162	210.76
299	139.00 - 139.50	64.00 - 64.50	2.803	.000	176.88	3.910	.166	170.41
300	139.00 - 139.50	64.50 - 65.00	2.803	.000	193.06	3.847	.156	163.30
301	139.00 - 139.50	65.00 - 65.50	2.803	.000	213.63	3.802	.151	151.97
302	139.00 - 139.50	65.50 - 66.00	2.803	.000	237.44	3.767	.142	138.81
303	139.00 - 139.50	66.00 - 66.50	2.803	.000	263.61	3.783	.142	130.64
304	139.00 - 139.50	66.50 - 67.00	.000	.000	.00	3.785	.155	123.76
305	139.00 - 139.50	67.00 - 67.50	.000	.000	.00	3.804	.164	122.15
306	139.00 - 139.50	67.50 - 68.00	3.062	.671	302.79	3.850	.182	129.11
307	139.00 - 139.50	68.00 - 68.50	.000	.000	.00	3.804	.164	137.79
308	139.00 - 139.50	68.50 - 69.00	.000	.000	.00	3.687	.200	141.10
309	139.00 - 139.50	69.00 - 69.50	.000	.000	.00	3.631	.168	148.80
310	139.00 - 139.50	69.50 - 70.00	.000	.000	.00	3.615	.172	151.29
311	139.00 - 139.50	70.00 - 70.50	.000	.000	.00	3.485	.170	140.70
312	139.00 - 139.50	70.50 - 71.00	.000	.000	.00	3.451	.165	146.62
313	139.50 - 140.00	55.00 - 55.50	3.152	.049	151.30	3.825	.287	175.76
314	139.50 - 140.00	55.50 - 56.00	4.032	.883	213.22	3.943	.224	165.08
315	139.50 - 140.00	56.00 - 56.50	4.052	.866	153.15	4.160	.177	165.28

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
316	139.50 - 140.00	56.50 - 57.00	4.067	.855	95.33	4.554	.239	175.04
317	139.50 - 140.00	57.00 - 57.50	4.322	.811	158.40	4.631	.223	94.49
318	139.50 - 140.00	57.50 - 58.00	4.354	.777	158.48	4.723	.214	160.92
319	139.50 - 140.00	58.00 - 58.50	4.354	.777	140.68	4.819	.199	145.07
320	139.50 - 140.00	58.50 - 59.00	4.354	.777	126.47	4.823	.196	120.38
321	139.50 - 140.00	59.00 - 59.50	4.354	.777	110.35	4.825	.196	119.90
322	139.50 - 140.00	59.50 - 60.00	4.354	.777	75.34	4.782	.197	84.23
323	139.50 - 140.00	60.00 - 60.50	4.358	.773	48.11	4.781	.197	67.55
324	139.50 - 140.00	60.50 - 61.00	4.358	.773	90.35	4.780	.198	79.88
325	139.50 - 140.00	61.00 - 61.50	4.322	.811	140.20	4.865	.202	87.26
326	139.50 - 140.00	61.50 - 62.00	4.311	.822	185.35	4.865	.202	119.36
327	139.50 - 140.00	62.00 - 62.50	4.046	.657	191.83	4.862	.205	160.71
328	139.50 - 140.00	62.50 - 63.00	4.031	.670	226.09	4.821	.197	193.90
329	139.50 - 140.00	63.00 - 63.50	4.013	.690	259.80	4.554	.159	198.27
330	139.50 - 140.00	63.50 - 64.00	3.223	.135	186.26	4.384	.138	206.24
331	139.50 - 140.00	64.00 - 64.50	3.006	.258	175.56	3.943	.165	171.27
332	139.50 - 140.00	64.50 - 65.00	3.006	.258	193.23	3.875	.145	168.68
333	139.50 - 140.00	65.00 - 65.50	3.006	.258	214.77	3.824	.140	160.43
334	139.50 - 140.00	65.50 - 66.00	2.803	.000	227.09	3.791	.127	149.85
335	139.50 - 140.00	66.00 - 66.50	3.245	.470	236.48	3.868	.165	147.40
336	139.50 - 140.00	66.50 - 67.00	3.062	.671	248.18	3.869	.175	142.94
337	139.50 - 140.00	67.00 - 67.50	3.062	.671	268.90	3.867	.178	140.64
338	139.50 - 140.00	67.50 - 68.00	3.062	.671	292.23	4.073	.160	170.03
339	139.50 - 140.00	68.00 - 68.50	.000	.000	.00	3.823	.156	149.03
340	139.50 - 140.00	68.50 - 69.00	.000	.000	.00	3.695	.199	145.40
341	139.50 - 140.00	69.00 - 69.50	.000	.000	.00	3.675	.172	150.33
342	139.50 - 140.00	69.50 - 70.00	.000	.000	.00	3.660	.177	147.66
343	139.50 - 140.00	70.00 - 70.50	.000	.000	.00	3.546	.173	135.92
344	139.50 - 140.00	70.50 - 71.00	.000	.000	.00	3.451	.165	135.09
345	140.00 - 140.50	55.00 - 55.50	3.103	.001	154.75	3.811	.310	191.80
346	140.00 - 140.50	55.50 - 56.00	4.019	.895	225.09	3.934	.240	181.18
347	140.00 - 140.50	56.00 - 56.50	4.043	.873	177.85	4.244	.193	186.42
348	140.00 - 140.50	56.50 - 57.00	4.060	.860	144.59	4.624	.238	189.23
349	140.00 - 140.50	57.00 - 57.50	4.317	.816	179.63	4.705	.218	154.38
350	140.00 - 140.50	57.50 - 58.00	4.349	.782	174.30	4.811	.205	169.86

SEISMIC MAP OF ALASKA

AREA	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
351	140.00 - 140.50	58.00 - 58.50	4.354	.777	156.86	4.897	.200	157.42
352	140.00 - 140.50	58.50 - 59.00	4.354	.777	139.63	4.902	.198	137.79
353	140.00 - 140.50	59.00 - 59.50	4.354	.777	113.41	4.905	.198	122.01
354	140.00 - 140.50	59.50 - 60.00	4.354	.777	53.63	4.869	.202	92.06
355	140.00 - 140.50	60.00 - 60.50	4.358	.773	24.99	4.867	.202	65.64
356	140.00 - 140.50	60.50 - 61.00	4.358	.773	63.07	4.866	.203	65.00
357	140.00 - 140.50	61.00 - 61.50	4.369	.769	142.94	4.992	.199	92.49
358	140.00 - 140.50	61.50 - 62.00	4.359	.779	189.72	4.991	.199	93.54
359	140.00 - 140.50	62.00 - 62.50	4.105	.606	194.40	4.986	.202	158.62
360	140.00 - 140.50	62.50 - 63.00	4.093	.618	226.08	4.941	.202	195.74
361	140.00 - 140.50	63.00 - 63.50	4.078	.634	256.12	4.688	.175	205.76
362	140.00 - 140.50	63.50 - 64.00	3.551	.290	197.32	4.456	.125	202.39
363	140.00 - 140.50	64.00 - 64.50	3.446	.382	193.42	4.035	.227	169.70
364	140.00 - 140.50	64.50 - 65.00	3.446	.382	204.10	3.957	.188	170.51
365	140.00 - 140.50	65.00 - 65.50	3.414	.414	215.47	3.897	.174	166.16
366	140.00 - 140.50	65.50 - 66.00	3.245	.470	206.56	3.872	.159	160.79
367	140.00 - 140.50	66.00 - 66.50	3.245	.470	224.71	4.104	.134	177.45
368	140.00 - 140.50	66.50 - 67.00	3.062	.671	236.11	4.105	.140	177.54
369	140.00 - 140.50	67.00 - 67.50	3.062	.671	257.79	4.095	.150	177.74
370	140.00 - 140.50	67.50 - 68.00	3.062	.671	282.05	4.144	.146	187.06
371	140.00 - 140.50	68.00 - 68.50	.000	.000	.00	3.845	.159	157.21
372	140.00 - 140.50	68.50 - 69.00	.000	.000	.00	3.716	.205	148.02
373	140.00 - 140.50	69.00 - 69.50	.000	.000	.00	3.675	.172	146.37
374	140.00 - 140.50	69.50 - 70.00	.000	.000	.00	3.660	.177	138.27
375	140.00 - 140.50	70.00 - 70.50	.000	.000	.00	3.546	.173	123.68
376	140.00 - 140.50	70.50 - 71.00	.000	.000	.00	3.451	.165	123.19
377	140.50 - 141.00	55.00 - 55.50	3.103	.001	164.16	3.513	.211	183.13
378	140.50 - 141.00	55.50 - 56.00	4.019	.895	240.88	3.731	.178	179.03
379	140.50 - 141.00	56.00 - 56.50	4.032	.883	202.31	4.247	.195	203.26
380	140.50 - 141.00	56.50 - 57.00	4.052	.866	177.35	4.629	.258	194.53
381	140.50 - 141.00	57.00 - 57.50	[illegible]	.822	199.99	4.748	.244	177.13
382	140.50 - 141.00	57.50 - 58.00	[illegible]	.788	189.73	4.859	.212	170.92
383	140.50 - 141.00	58.00 - 58.50	[illegible]	.777	171.64	5.012	.206	164.31
384	140.50 - 141.00	58.50 - 59.00	[illegible]	.777	151.10	5.017	.203	143.35
385	140.50 - 141.00	59.00 - 59.50	4.391	.744	125.06	5.019	.203	123.31

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
386	140.50 - 141.00	59.50 - 60.00	4.391	.744	78.89	4.993	.201	85.25
387	140.50 - 141.00	60.00 - 60.50	4.395	.740	49.71	4.992	.200	43.17
388	140.50 - 141.00	60.50 - 61.00	4.395	.740	92.35	4.991	.200	43.26
389	140.50 - 141.00	61.00 - 61.50	4.373	.764	144.06	5.092	.185	106.75
390	140.50 - 141.00	61.50 - 62.00	4.421	.744	198.44	5.094	.186	97.96
391	140.50 - 141.00	62.00 - 62.50	4.183	.574	200.34	5.088	.187	147.65
392	140.50 - 141.00	62.50 - 63.00	4.172	.586	226.28	5.049	.186	195.37
393	140.50 - 141.00	63.00 - 63.50	4.159	.601	247.85	4.822	.160	209.38
394	140.50 - 141.00	63.50 - 64.00	3.571	.267	182.19	4.599	.138	204.01
395	140.50 - 141.00	64.00 - 64.50	3.470	.361	180.08	4.337	.142	193.21
396	140.50 - 141.00	64.50 - 65.00	3.446	.382	189.98	4.144	.183	179.08
397	140.50 - 141.00	65.00 - 65.50	3.414	.414	201.76	4.059	.155	174.86
398	140.50 - 141.00	65.50 - 66.00	3.245	.470	194.29	3.995	.130	170.62
399	140.50 - 141.00	66.00 - 66.50	3.245	.470	213.19	4.193	.127	185.18
400	140.50 - 141.00	66.50 - 67.00	3.062	.671	224.35	4.185	.132	187.96
401	140.50 - 141.00	67.00 - 67.50	3.062	.671	247.07	4.172	.142	190.74
402	140.50 - 141.00	67.50 - 68.00	3.331	.428	246.42	4.145	.144	193.65
403	140.50 - 141.00	68.00 - 68.50	3.201	.000	299.81	3.846	.159	162.44
404	140.50 - 141.00	68.50 - 69.00	.000	.000	.00	3.716	.205	148.54
405	140.50 - 141.00	69.00 - 69.50	.000	.000	.00	3.744	.188	149.05
406	140.50 - 141.00	69.50 - 70.00	.000	.000	.00	3.731	.192	135.69
407	140.50 - 141.00	70.00 - 70.50	.000	.000	.00	3.546	.173	110.36
408	140.50 - 141.00	70.50 - 71.00	.000	.000	.00	3.451	.165	111.02
409	141.00 - 141.50	55.00 - 55.50	3.103	.001	175.49	3.337	.206	188.71
410	141.00 - 141.50	55.50 - 56.00	4.019	.895	257.96	3.567	.171	173.94
411	141.00 - 141.50	56.00 - 56.50	4.032	.883	225.30	4.213	.178	206.37
412	141.00 - 141.50	56.50 - 57.00	4.052	.866	202.52	4.709	.224	206.12
413	141.00 - 141.50	57.00 - 57.50	4.317	.816	219.11	4.898	.221	195.16
414	141.00 - 141.50	57.50 - 58.00	4.349	.782	205.40	4.977	.210	177.45
415	141.00 - 141.50	58.00 - 58.50	4.349	.782	185.00	5.088	.194	162.24
416	141.00 - 141.50	58.50 - 59.00	4.354	.777	162.31	5.094	.190	139.17
417	141.00 - 141.50	59.00 - 59.50	4.391	.744	135.80	5.096	.190	118.17
418	141.00 - 141.50	59.50 - 60.00	4.391	.744	97.54	5.091	.187	90.63
419	141.00 - 141.50	60.00 - 60.50	4.395	.740	76.43	5.091	.187	61.57
420	141.00 - 141.50	60.50 - 61.00	4.395	.740	103.76	5.091	.187	68.69

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
421	141.00 - 141.50	61.00 - 61.50	4.373	.764	147.37	5.173	.185	107.63
422	141.00 - 141.50	61.50 - 62.00	4.426	.739	198.86	5.187	.186	115.84
423	141.00 - 141.50	62.00 - 62.50	4.188	.570	196.02	5.183	.186	119.92
424	141.00 - 141.50	62.50 - 63.00	4.178	.580	217.26	5.149	.186	195.33
425	141.00 - 141.50	63.00 - 63.50	4.166	.593	234.07	4.952	.165	209.73
426	141.00 - 141.50	63.50 - 64.00	3.648	.204	173.02	4.704	.138	202.65
427	141.00 - 141.50	64.00 - 64.50	3.588	.249	179.59	4.513	.124	199.82
428	141.00 - 141.50	64.50 - 65.00	3.470	.361	177.74	4.328	.117	187.55
429	141.00 - 141.50	65.00 - 65.50	3.414	.414	188.24	4.120	.171	165.35
430	141.00 - 141.50	65.50 - 66.00	3.245	.470	182.22	4.071	.158	165.71
431	141.00 - 141.50	66.00 - 66.50	3.379	.425	173.86	4.133	.172	176.06
432	141.00 - 141.50	66.50 - 67.00	3.350	.425	195.61	4.116	.168	180.63
433	141.00 - 141.50	67.00 - 67.50	3.350	.425	213.66	4.074	.159	181.41
434	141.00 - 141.50	67.50 - 68.00	3.566	.457	267.51	4.160	.149	197.01
435	141.00 - 141.50	68.00 - 68.50	3.201	.000	289.55	3.869	.175	166.28
436	141.00 - 141.50	68.50 - 69.00	.000	.000	.00	3.747	.224	149.59
437	141.00 - 141.50	69.00 - 69.50	.000	.000	.00	3.744	.188	142.24
438	141.00 - 141.50	69.50 - 70.00	.000	.000	.00	3.731	.192	123.19
439	141.00 - 141.50	70.00 - 70.50	.000	.000	.00	3.546	.173	96.02
440	141.00 - 141.50	70.50 - 71.00	.000	.000	.00	3.451	.165	98.72
441	141.00 - 141.50	71.00 - 71.50	.000	.000	.00	3.373	.217	115.35
442	141.00 - 141.50	71.50 - 72.00	.000	.000	.00	3.304	.248	136.85
443	141.50 - 142.00	55.00 - 55.50	3.041	.061	184.78	3.257	.175	192.02
444	141.50 - 142.00	55.50 - 56.00	4.003	.912	275.09	3.534	.151	179.07
445	141.50 - 142.00	56.00 - 56.50	4.019	.895	246.35	4.230	.185	210.53
446	141.50 - 142.00	56.50 - 57.00	4.032	.883	224.01	4.766	.217	208.94
447	141.50 - 142.00	57.00 - 57.50	4.297	.836	235.81	5.002	.205	201.02
448	141.50 - 142.00	57.50 - 58.00	4.331	.801	219.88	5.069	.201	178.75
449	141.50 - 142.00	58.00 - 58.50	4.354	.777	198.41	5.157	.189	156.58
450	141.50 - 142.00	58.50 - 59.00	4.358	.773	173.62	5.166	.188	132.21
451	141.50 - 142.00	59.00 - 59.50	4.395	.740	146.85	5.171	.188	110.15
452	141.50 - 142.00	59.50 - 60.00	4.395	.740	105.98	5.171	.187	91.74
453	141.50 - 142.00	60.00 - 60.50	4.399	.736	67.84	5.171	.187	80.01
454	141.50 - 142.00	60.50 - 61.00	4.399	.736	108.59	5.172	.186	90.10
455	141.50 - 142.00	61.00 - 61.50	4.399	.736	154.25	5.234	.184	113.17

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
456	141.50 - 142.00	61.50 - 62.00	4.449	.713	201.74	5.249	.185	142.35
457	141.50 - 142.00	62.00 - 62.50	4.213	.542	193.05	5.246	.185	158.66
458	141.50 - 142.00	62.50 - 63.00	4.209	.546	208.73	5.207	.184	194.28
459	141.50 - 142.00	63.00 - 63.50	4.199	.557	220.14	5.027	.166	205.70
460	141.50 - 142.00	63.50 - 64.00	3.756	.120	156.77	4.727	.128	191.85
461	141.50 - 142.00	64.00 - 64.50	3.717	.148	162.76	4.540	.118	187.20
462	141.50 - 142.00	64.50 - 65.00	3.557	.324	152.01	4.366	.114	176.67
463	141.50 - 142.00	65.00 - 65.50	3.535	.327	160.39	4.169	.188	158.05
464	141.50 - 142.00	65.50 - 66.00	3.379	.425	150.46	4.128	.173	161.76
465	141.50 - 142.00	66.00 - 66.50	3.610	.434	189.78	4.143	.182	168.51
466	141.50 - 142.00	66.50 - 67.00	3.583	.447	211.69	4.117	.169	174.21
467	141.50 - 142.00	67.00 - 67.50	3.583	.447	232.47	4.069	.165	176.16
468	141.50 - 142.00	67.50 - 68.00	3.583	.447	254.02	4.053	.163	183.25
469	141.50 - 142.00	68.00 - 68.50	3.280	.000	282.66	3.726	.234	149.98
470	141.50 - 142.00	68.50 - 69.00	.000	.000	.00	3.757	.183	152.24
471	141.50 - 142.00	69.00 - 69.50	.000	.000	.00	3.744	.188	134.73
472	141.50 - 142.00	69.50 - 70.00	.000	.000	.00	3.731	.192	109.87
473	141.50 - 142.00	70.00 - 70.50	.000	.000	.00	3.546	.173	80.70
474	141.50 - 142.00	70.50 - 71.00	.000	.000	.00	3.451	.165	86.53
475	141.50 - 142.00	71.00 - 71.50	.000	.000	.00	3.373	.217	106.44
476	141.50 - 142.00	71.50 - 72.00	.000	.000	.00	3.304	.248	130.02
477	142.00 - 142.50	55.00 - 55.50	2.953	.149	195.23	3.257	.175	192.88
478	142.00 - 142.50	55.50 - 56.00	3.980	.938	292.10	3.521	.151	179.79
479	142.00 - 142.50	56.00 - 56.50	4.003	.912	267.10	4.238	.199	210.22
480	142.00 - 142.50	56.50 - 57.00	4.019	.895	245.34	4.810	.217	208.64
481	142.00 - 142.50	57.00 - 57.50	4.288	.846	252.39	5.065	.201	200.82
482	142.00 - 142.50	57.50 - 58.00	4.323	.809	234.27	5.128	.198	176.35
483	142.00 - 142.50	58.00 - 58.50	4.362	.771	214.67	5.202	.190	151.60
484	142.00 - 142.50	58.50 - 59.00	4.372	.760	188.23	5.222	.190	118.11
485	142.00 - 142.50	59.00 - 59.50	4.407	.729	159.62	5.226	.190	95.27
486	142.00 - 142.50	59.50 - 60.00	4.407	.729	110.85	5.227	.189	71.59
487	142.00 - 142.50	60.00 - 60.50	4.411	.724	39.05	5.229	.188	71.96
488	142.00 - 142.50	60.50 - 61.00	4.411	.724	110.62	5.231	.186	79.48
489	142.00 - 142.50	61.00 - 61.50	4.443	.694	161.81	5.260	.177	119.00
490	142.00 - 142.50	61.50 - 62.00	4.490	.671	205.17	5.275	.178	146.67

SEISMIC MAP OF ALASKA

GSID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
491	142.00 - 142.50	62.00 - 62.50	4.271	.487	189.36	5.271	.178	168.84
492	142.00 - 142.50	62.50 - 63.00	4.268	.489	196.60	5.231	.178	189.14
493	142.00 - 142.50	63.00 - 63.50	4.262	.495	199.89	5.052	.160	197.04
494	142.00 - 142.50	63.50 - 64.00	3.897	.215	156.15	4.748	.118	180.53
495	142.00 - 142.50	64.00 - 64.50	3.862	.243	163.88	4.566	.108	174.58
496	142.00 - 142.50	64.50 - 65.00	3.725	.376	155.90	4.399	.108	165.39
497	142.00 - 142.50	65.00 - 65.50	3.704	.387	163.65	4.201	.202	148.39
498	142.00 - 142.50	65.50 - 66.00	3.610	.434	163.04	4.159	.188	153.32
499	142.00 - 142.50	66.00 - 66.50	3.632	.428	175.80	4.151	.184	161.22
500	142.00 - 142.50	66.50 - 67.00	3.610	.434	197.12	4.123	.170	168.42
501	142.00 - 142.50	67.00 - 67.50	3.610	.434	218.03	4.073	.165	172.48
502	142.00 - 142.50	67.50 - 68.00	3.563	.447	244.63	4.046	.150	177.19
503	142.00 - 142.50	68.00 - 68.50	3.280	.000	273.06	3.862	.144	167.93
504	142.00 - 142.50	68.50 - 69.00	.000	.000	.00	3.811	.157	154.23
505	142.00 - 142.50	69.00 - 69.50	.000	.000	.00	3.744	.188	127.01
506	142.00 - 142.50	69.50 - 70.00	.000	.000	.00	3.731	.192	96.38
507	142.00 - 142.50	70.00 - 70.50	.000	.000	.00	3.546	.173	64.48
508	142.00 - 142.50	70.50 - 71.00	.000	.000	.00	3.451	.165	74.84
509	142.00 - 142.50	71.00 - 71.50	.000	.000	.00	3.373	.217	98.36
510	142.00 - 142.50	71.50 - 72.00	.000	.000	.00	3.321	.226	124.99
511	142.50 - 143.00	55.00 - 55.50	2.502	.000	168.36	3.257	.175	191.97
512	142.50 - 143.00	55.50 - 56.00	2.502	.000	149.65	3.484	.164	176.90
513	142.50 - 143.00	56.00 - 56.50	2.803	.000	171.32	4.315	.233	215.14
514	142.50 - 143.00	56.50 - 57.00	2.979	.000	177.92	4.851	.220	206.86
515	142.50 - 143.00	57.00 - 57.50	3.952	.764	259.49	5.106	.204	197.49
516	142.50 - 143.00	57.50 - 58.00	4.023	.679	237.61	5.165	.198	171.65
517	142.50 - 143.00	58.00 - 58.50	4.398	.739	231.97	5.224	.185	143.46
518	142.50 - 143.00	58.50 - 59.00	4.407	.730	203.80	5.243	.184	69.47
519	142.50 - 143.00	59.00 - 59.50	4.439	.700	174.52	5.247	.184	71.58
520	142.50 - 143.00	59.50 - 60.00	4.439	.700	126.52	5.249	.183	42.86
521	142.50 - 143.00	60.00 - 60.50	4.443	.695	75.44	5.251	.183	71.86
522	142.50 - 143.00	60.50 - 61.00	4.443	.695	121.05	5.255	.181	81.81
523	142.50 - 143.00	61.00 - 61.50	4.436	.700	161.43	5.296	.175	112.07
524	142.50 - 143.00	61.50 - 62.00	4.525	.658	208.70	5.310	.175	144.61
525	142.50 - 143.00	62.00 - 62.50	4.313	.477	187.82	5.304	.176	168.22

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
526	142.50 - 143.00	62.50 - 63.00	4.310	.480	186.16	5.266	.177	179.15
527	142.50 - 143.00	63.00 - 63.50	4.307	.483	179.55	5.074	.156	187.54
528	142.50 - 143.00	63.50 - 64.00	4.046	.229	154.16	4.771	.115	168.66
529	142.50 - 143.00	64.00 - 64.50	3.919	.202	153.42	4.587	.106	162.05
530	142.50 - 143.00	64.50 - 65.00	3.750	.368	142.24	4.415	.107	153.51
531	142.50 - 143.00	65.00 - 65.50	3.725	.376	149.26	4.219	.212	138.90
532	142.50 - 143.00	65.50 - 66.00	3.632	.428	149.34	4.174	.197	145.20
533	142.50 - 143.00	66.00 - 66.50	3.632	.428	164.94	4.296	.110	169.17
534	142.50 - 143.00	66.50 - 67.00	3.610	.434	186.46	4.158	.176	162.51
535	142.50 - 143.00	67.00 - 67.50	3.610	.434	208.42	4.083	.162	166.01
536	142.50 - 143.00	67.50 - 68.00	3.678	.356	249.59	4.200	.111	189.07
537	142.50 - 143.00	68.00 - 68.50	3.280	.000	263.90	3.935	.282	163.71
538	142.50 - 143.00	68.50 - 69.00	.000	.000	.00	3.881	.130	156.97
539	142.50 - 143.00	69.00 - 69.50	.000	.000	.00	3.744	.188	119.59
540	142.50 - 143.00	69.50 - 70.00	.000	.000	.00	3.731	.192	83.74
541	142.50 - 143.00	70.00 - 70.50	.000	.000	.00	3.546	.173	47.51
542	142.50 - 143.00	70.50 - 71.00	.000	.000	.00	3.461	.151	64.86
543	142.50 - 143.00	71.00 - 71.50	.000	.000	.00	3.387	.198	92.27
544	142.50 - 143.00	71.50 - 72.00	.000	.000	.00	3.321	.226	119.81
545	143.00 - 143.50	55.00 - 55.50	2.502	.000	183.61	3.295	.162	190.37
546	143.00 - 143.50	55.50 - 56.00	2.502	.000	166.62	3.521	.151	175.38
547	143.00 - 143.50	56.00 - 56.50	2.502	.000	155.53	4.352	.217	212.29
548	143.00 - 143.50	56.50 - 57.00	2.803	.000	178.63	4.874	.216	202.26
549	143.00 - 143.50	57.00 - 57.50	4.013	.690	284.09	5.132	.199	192.56
550	143.00 - 143.50	57.50 - 58.00	4.053	.651	251.17	5.189	.192	166.06
551	143.00 - 143.50	58.00 - 58.50	4.128	.584	218.34	5.260	.186	139.77
552	143.00 - 143.50	58.50 - 59.00	4.138	.576	183.59	5.279	.185	94.07
553	143.00 - 143.50	59.00 - 59.50	4.180	.536	154.07	5.283	.184	67.38
554	143.00 - 143.50	59.50 - 60.00	4.180	.536	116.36	5.285	.183	57.21
555	143.00 - 143.50	60.00 - 60.50	4.184	.532	89.77	5.288	.182	73.01
556	143.00 - 143.50	60.50 - 61.00	4.184	.532	95.92	5.291	.180	75.22
557	143.00 - 143.50	61.00 - 61.50	4.520	.642	165.74	5.155	.406	76.84
558	143.00 - 143.50	61.50 - 62.00	4.587	.611	208.32	5.164	.410	117.12
559	143.00 - 143.50	62.00 - 62.50	4.377	.444	181.95	5.158	.407	137.55
560	143.00 - 143.50	62.50 - 63.00	4.375	.446	172.18	5.128	.395	129.87

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
561	143.00 - 143.50	63.00 - 63.50	4.371	.450	151.20	5.090	.150	177.12
562	143.00 - 143.50	63.50 - 64.00	4.046	.229	135.26	4.751	.220	143.72
563	143.00 - 143.50	64.00 - 64.50	3.919	.202	140.35	4.619	.166	146.61
564	143.00 - 143.50	64.50 - 65.00	3.750	.368	129.65	4.483	.120	144.23
565	143.00 - 143.50	65.00 - 65.50	3.725	.376	136.27	4.353	.126	140.28
566	143.00 - 143.50	65.50 - 66.00	3.632	.428	137.73	4.320	.116	150.00
567	143.00 - 143.50	66.00 - 66.50	3.722	.328	164.93	4.422	.130	170.61
568	143.00 - 143.50	66.50 - 67.00	3.702	.339	187.74	4.275	.098	161.97
569	143.00 - 143.50	67.00 - 67.50	3.702	.339	211.66	4.219	.110	172.02
570	143.00 - 143.50	67.50 - 68.00	3.678	.356	240.66	4.196	.107	182.52
571	143.00 - 143.50	68.00 - 68.50	3.280	.000	255.23	3.926	.279	157.84
572	143.00 - 143.50	68.50 - 69.00	.000	.000	.00	3.855	.125	148.29
573	143.00 - 143.50	69.00 - 69.50	.000	.000	.00	3.750	.180	113.39
574	143.00 - 143.50	69.50 - 70.00	.000	.000	.00	3.737	.185	73.77
575	143.00 - 143.50	70.00 - 70.50	.000	.000	.00	3.554	.161	30.83
576	143.00 - 143.50	70.50 - 71.00	.000	.000	.00	3.461	.151	56.30
577	143.00 - 143.50	71.00 - 71.50	.000	.000	.00	3.387	.198	86.34
578	143.00 - 143.50	71.50 - 72.00	.000	.000	.00	3.321	.226	115.61
579	143.50 - 144.00	55.00 - 55.50	2.502	.000	199.49	3.449	.176	192.70
580	143.50 - 144.00	55.50 - 56.00	2.502	.000	183.97	3.783	.176	197.95
581	143.50 - 144.00	56.00 - 56.50	2.502	.000	173.99	4.410	.216	209.45
582	143.50 - 144.00	56.50 - 57.00	2.803	.000	196.02	4.933	.212	201.56
583	143.50 - 144.00	57.00 - 57.50	4.000	.704	293.58	5.175	.200	188.98
584	143.50 - 144.00	57.50 - 58.00	4.043	.663	259.37	5.228	.193	161.43
585	143.50 - 144.00	58.00 - 58.50	4.238	.517	236.06	5.127	.399	115.66
586	143.50 - 144.00	58.50 - 59.00	4.248	.509	201.47	5.142	.405	88.25
587	143.50 - 144.00	59.00 - 59.50	4.276	.484	172.27	5.146	.406	59.74
588	143.50 - 144.00	59.50 - 60.00	4.276	.484	139.79	5.148	.406	45.81
589	143.50 - 144.00	60.00 - 60.50	4.279	.481	111.26	5.150	.407	57.55
590	143.50 - 144.00	60.50 - 61.00	4.279	.481	78.21	5.153	.407	47.98
591	143.50 - 144.00	61.00 - 61.50	4.286	.475	124.33	5.275	.271	86.06
592	143.50 - 144.00	61.50 - 62.00	4.365	.456	163.98	5.274	.268	123.38
593	143.50 - 144.00	62.00 - 62.50	4.377	.444	171.82	5.228	.314	139.55
594	143.50 - 144.00	62.50 - 63.00	4.375	.446	153.23	5.199	.302	133.71
595	143.50 - 144.00	63.00 - 63.50	4.371	.450	102.78	4.991	.329	146.76

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
596	143.50 - 144.00	63.50 - 64.00	4.079	.208	120.06	4.847	.142	126.80
597	143.50 - 144.00	64.00 - 64.50	3.960	.177	130.87	4.731	.105	143.55
598	143.50 - 144.00	64.50 - 65.00	3.824	.285	123.63	4.618	.087	143.71
599	143.50 - 144.00	65.00 - 65.50	3.802	.296	130.31	4.487	.118	139.22
600	143.50 - 144.00	65.50 - 66.00	3.722	.328	135.47	4.454	.122	149.16
601	143.50 - 144.00	66.00 - 66.50	3.722	.328	154.01	4.439	.119	161.28
602	143.50 - 144.00	66.50 - 67.00	3.702	.339	177.41	4.265	.090	145.25
603	143.50 - 144.00	67.00 - 67.50	3.702	.339	202.50	4.206	.103	162.29
604	143.50 - 144.00	67.50 - 68.00	3.678	.356	232.29	4.194	.107	175.45
605	143.50 - 144.00	68.00 - 68.50	3.280	.000	247.11	3.920	.277	151.70
606	143.50 - 144.00	68.50 - 69.00	.000	.000	.00	3.829	.123	139.99
607	143.50 - 144.00	69.00 - 69.50	.000	.000	.00	3.720	.168	104.41
608	143.50 - 144.00	69.50 - 70.00	.000	.000	.00	3.706	.173	64.96
609	143.50 - 144.00	70.00 - 70.50	.000	.000	.00	3.554	.161	19.83
610	143.50 - 144.00	70.50 - 71.00	.000	.000	.00	3.461	.151	50.52
611	143.50 - 144.00	71.00 - 71.50	.000	.000	.00	3.387	.198	81.54
612	143.50 - 144.00	71.50 - 72.00	.000	.000	.00	3.321	.226	112.48
613	144.00 - 144.50	55.00 - 55.50	2.502	.000	215.86	3.736	.187	204.03
614	144.00 - 144.50	55.50 - 56.00	2.502	.000	201.60	3.998	.195	203.48
615	144.00 - 144.50	56.00 - 56.50	2.502	.000	192.54	4.477	.216	204.71
616	144.00 - 144.50	56.50 - 57.00	2.979	.000	227.51	4.870	.313	177.33
617	144.00 - 144.50	57.00 - 57.50	4.013	.690	299.69	5.056	.377	157.27
618	144.00 - 144.50	57.50 - 58.00	4.159	.590	275.61	5.100	.392	127.81
619	144.00 - 144.50	58.00 - 58.50	4.235	.520	240.32	5.217	.319	118.24
620	144.00 - 144.50	58.50 - 59.00	4.245	.511	205.99	5.232	.324	91.06
621	144.00 - 144.50	59.00 - 59.50	4.273	.486	178.30	5.236	.325	60.99
622	144.00 - 144.50	59.50 - 60.00	4.273	.486	148.28	5.236	.324	36.54
623	144.00 - 144.50	60.00 - 60.50	4.276	.484	113.86	5.272	.273	60.26
624	144.00 - 144.50	60.50 - 61.00	4.276	.484	44.09	5.274	.272	59.80
625	144.00 - 144.50	61.00 - 61.50	4.302	.463	118.54	5.325	.247	94.67
626	144.00 - 144.50	61.50 - 62.00	4.388	.436	156.62	5.312	.237	121.10
627	144.00 - 144.50	62.00 - 62.50	4.399	.426	161.21	5.273	.263	138.02
628	144.00 - 144.50	62.50 - 63.00	4.399	.426	140.61	5.245	.251	148.30
629	144.00 - 144.50	63.00 - 63.50	4.396	.429	61.29	5.066	.237	145.91
630	144.00 - 144.50	63.50 - 64.00	4.116	.190	111.75	4.866	.143	91.13

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
631	144.00 - 144.50	64.00 - 64.50	4.002	.154	124.47	4.757	.103	132.10
632	144.00 - 144.50	64.50 - 65.00	3.824	.285	109.79	4.641	.077	130.82
633	144.00 - 144.50	65.00 - 65.50	3.802	.296	116.36	4.515	.114	127.93
634	144.00 - 144.50	65.50 - 66.00	3.722	.328	123.52	4.483	.114	138.37
635	144.00 - 144.50	66.00 - 66.50	3.722	.328	143.48	4.477	.115	152.88
636	144.00 - 144.50	66.50 - 67.00	3.702	.339	167.63	4.272	.088	116.18
637	144.00 - 144.50	67.00 - 67.50	3.702	.339	193.94	4.210	.101	151.73
638	144.00 - 144.50	67.50 - 68.00	3.678	.356	224.54	4.178	.104	166.21
639	144.00 - 144.50	68.00 - 68.50	3.280	.000	239.58	3.892	.272	142.35
640	144.00 - 144.50	68.50 - 69.00	.000	.000	.00	3.749	.109	125.53
641	144.00 - 144.50	69.00 - 69.50	.000	.000	.00	3.671	.192	94.58
642	144.00 - 144.50	69.50 - 70.00	.000	.000	.00	3.671	.192	59.70
643	144.00 - 144.50	70.00 - 70.50	.000	.000	.00	3.535	.166	18.89
644	144.00 - 144.50	70.50 - 71.00	.000	.000	.00	3.461	.151	46.59
645	144.00 - 144.50	71.00 - 71.50	.000	.000	.00	3.387	.198	77.80
646	144.00 - 144.50	71.50 - 72.00	.000	.000	.00	3.321	.226	110.50
647	144.50 - 145.00	55.00 - 55.50	.000	.000	.00	4.140	.265	207.90
648	144.50 - 145.00	55.50 - 56.00	.000	.000	.00	4.378	.226	206.44
649	144.50 - 145.00	56.00 - 56.50	.000	.000	.00	4.556	.262	180.45
650	144.50 - 145.00	56.50 - 57.00	2.803	.000	259.64	4.984	.259	180.60
651	144.50 - 145.00	57.00 - 57.50	4.000	.704	313.24	5.148	.302	160.00
652	144.50 - 145.00	57.50 - 58.00	4.153	.597	282.94	5.189	.312	108.48
653	144.50 - 145.00	58.00 - 58.50	4.254	.505	240.16	5.276	.280	112.95
654	144.50 - 145.00	58.50 - 59.00	4.263	.498	206.91	5.294	.285	86.38
655	144.50 - 145.00	59.00 - 59.50	4.293	.470	180.52	5.299	.285	49.16
656	144.50 - 145.00	59.50 - 60.00	4.293	.470	151.44	5.299	.283	31.51
657	144.50 - 145.00	60.00 - 60.50	4.295	.468	119.91	5.327	.250	51.69
658	144.50 - 145.00	60.50 - 61.00	4.295	.468	79.71	5.326	.248	56.22
659	144.50 - 145.00	61.00 - 61.50	4.323	.446	121.70	5.340	.250	89.14
660	144.50 - 145.00	61.50 - 62.00	4.403	.426	147.35	5.320	.237	114.08
661	144.50 - 145.00	62.00 - 62.50	4.414	.416	148.19	5.281	.264	130.37
662	144.50 - 145.00	62.50 - 63.00	4.414	.416	136.38	5.254	.252	142.06
663	144.50 - 145.00	63.00 - 63.50	4.410	.419	61.90	5.078	.238	132.97
664	144.50 - 145.00	63.50 - 64.00	4.213	.205	117.82	4.912	.159	117.24
665	144.50 - 145.00	64.00 - 64.50	4.028	.136	115.74	4.816	.121	124.74

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
666	144.50 - 145.00	64.50 - 65.00	3.830	.283	95.25	4.700	.082	120.63
667	144.50 - 145.00	65.00 - 65.50	3.802	.296	102.11	4.589	.092	121.02
668	144.50 - 145.00	65.50 - 66.00	3.722	.328	111.89	4.521	.115	126.27
669	144.50 - 145.00	66.00 - 66.50	3.722	.328	133.42	4.481	.115	142.42
670	144.50 - 145.00	66.50 - 67.00	3.702	.339	158.50	4.272	.088	82.79
671	144.50 - 145.00	67.00 - 67.50	3.702	.339	186.04	4.210	.101	142.96
672	144.50 - 145.00	67.50 - 68.00	3.678	.356	217.45	4.178	.101	155.23
673	144.50 - 145.00	68.00 - 68.50	3.280	.000	232.71	3.890	.271	132.34
674	144.50 - 145.00	68.50 - 69.00	.000	.000	.00	3.742	.101	118.08
675	144.50 - 145.00	69.00 - 69.50	.000	.000	.00	3.558	.175	80.29
676	144.50 - 145.00	69.50 - 70.00	.000	.000	.00	3.558	.175	50.20
677	144.50 - 145.00	70.00 - 70.50	.000	.000	.00	3.437	.157	26.02
678	144.50 - 145.00	70.50 - 71.00	.000	.000	.00	3.461	.151	39.30
679	144.50 - 145.00	71.00 - 71.50	.000	.000	.00	3.387	.198	75.40
680	144.50 - 145.00	71.50 - 72.00	.000	.000	.00	3.321	.226	109.79
681	145.00 - 145.50	55.00 - 55.50	.000	.000	.00	4.430	.256	218.10
682	145.00 - 145.50	55.50 - 56.00	.000	.000	.00	4.621	.240	209.79
683	145.00 - 145.50	56.00 - 56.50	.000	.000	.00	4.747	.235	185.90
684	145.00 - 145.50	56.50 - 57.00	2.803	.000	259.33	5.068	.241	178.66
685	145.00 - 145.50	57.00 - 57.50	4.043	.663	320.65	5.213	.269	159.42
686	145.00 - 145.50	57.50 - 58.00	4.177	.574	285.13	5.250	.276	134.56
687	145.00 - 145.50	58.00 - 58.50	4.282	.480	245.01	5.296	.287	117.67
688	145.00 - 145.50	58.50 - 59.00	4.290	.472	210.35	5.314	.291	88.71
689	145.00 - 145.50	59.00 - 59.50	4.314	.454	181.74	5.318	.291	44.44
690	145.00 - 145.50	59.50 - 60.00	4.314	.454	150.04	5.320	.290	37.38
691	145.00 - 145.50	60.00 - 60.50	4.319	.450	121.56	5.349	.256	44.37
692	145.00 - 145.50	60.50 - 61.00	4.319	.450	110.64	5.346	.254	49.47
693	145.00 - 145.50	61.00 - 61.50	4.384	.421	126.87	5.391	.236	78.32
694	145.00 - 145.50	61.50 - 62.00	4.447	.411	136.15	5.346	.246	106.07
695	145.00 - 145.50	62.00 - 62.50	4.457	.402	129.42	5.304	.272	120.43
696	145.00 - 145.50	62.50 - 63.00	4.457	.402	138.80	5.276	.258	127.46
697	145.00 - 145.50	63.00 - 63.50	4.454	.405	106.11	5.109	.250	111.82
698	145.00 - 145.50	63.50 - 64.00	4.213	.205	119.99	4.933	.168	117.89
699	145.00 - 145.50	64.00 - 64.50	4.028	.136	103.90	4.839	.130	112.28
700	145.00 - 145.50	64.50 - 65.00	3.830	.283	78.39	4.730	.093	106.46

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
701	145.00 - 145.50	65.00 - 65.50	3.802	.296	87.74	4.605	.099	108.10
702	145.00 - 145.50	65.50 - 66.00	3.722	.328	100.75	4.534	.118	105.35
703	145.00 - 145.50	66.00 - 66.50	3.722	.328	123.94	4.483	.113	133.64
704	145.00 - 145.50	66.50 - 67.00	3.702	.339	150.10	4.274	.086	109.07
705	145.00 - 145.50	67.00 - 67.50	3.702	.339	178.88	4.211	.098	136.41
706	145.00 - 145.50	67.50 - 68.00	3.713	.333	209.53	4.181	.102	141.66
707	145.00 - 145.50	68.00 - 68.50	3.405	.000	239.44	3.892	.272	120.77
708	145.00 - 145.50	68.50 - 69.00	.000	.000	.00	3.738	.107	110.20
709	145.00 - 145.50	69.00 - 69.50	.000	.000	.00	3.537	.184	74.50
710	145.00 - 145.50	69.50 - 70.00	.000	.000	.00	3.537	.184	38.50
711	145.00 - 145.50	70.00 - 70.50	.000	.000	.00	3.411	.165	37.34
712	145.00 - 145.50	70.50 - 71.00	.000	.000	.00	3.437	.157	29.55
713	145.00 - 145.50	71.00 - 71.50	.000	.000	.00	3.356	.211	73.28
714	145.00 - 145.50	71.50 - 72.00	.000	.000	.00	3.321	.226	110.43
715	145.50 - 146.00	55.00 - 55.50	.000	.000	.00	4.578	.243	216.05
716	145.50 - 146.00	55.50 - 56.00	.000	.000	.00	4.708	.234	199.40
717	145.50 - 146.00	56.00 - 56.50	.000	.000	.00	4.812	.235	177.44
718	145.50 - 146.00	56.50 - 57.00	2.502	.000	240.31	5.099	.247	169.55
719	145.50 - 146.00	57.00 - 57.50	3.492	.298	233.65	5.235	.275	146.93
720	145.50 - 146.00	57.50 - 58.00	3.780	.289	217.39	5.270	.282	136.32
721	145.50 - 146.00	58.00 - 58.50	4.348	.451	246.32	5.362	.273	122.05
722	145.50 - 146.00	58.50 - 59.00	4.357	.442	211.67	5.379	.277	94.26
723	145.50 - 146.00	59.00 - 59.50	4.376	.428	181.96	5.387	.277	55.89
724	145.50 - 146.00	59.50 - 60.00	4.376	.428	146.12	5.388	.275	38.96
725	145.50 - 146.00	60.00 - 60.50	4.380	.424	102.56	5.412	.250	36.81
726	145.50 - 146.00	60.50 - 61.00	4.380	.424	118.16	5.406	.246	54.92
727	145.50 - 146.00	61.00 - 61.50	4.384	.421	118.55	5.412	.243	78.36
728	145.50 - 146.00	61.50 - 62.00	4.447	.411	117.37	5.363	.251	91.23
729	145.50 - 146.00	62.00 - 62.50	4.457	.402	91.29	5.319	.276	102.37
730	145.50 - 146.00	62.50 - 63.00	4.457	.402	134.73	5.290	.263	129.95
731	145.50 - 146.00	63.00 - 63.50	4.454	.405	139.93	5.124	.256	118.02
732	145.50 - 146.00	63.50 - 64.00	4.216	.203	122.19	4.949	.174	103.55
733	145.50 - 146.00	64.00 - 64.50	4.031	.134	91.55	4.858	.138	94.93
734	145.50 - 146.00	64.50 - 65.00	3.830	.283	58.67	4.754	.103	88.73
735	145.50 - 146.00	65.00 - 65.50	3.802	.296	73.89	4.632	.084	96.35

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
736	145.50 - 146.00	65.50 - 66.00	3.722	.328	90.28	4.566	.092	80.74
737	145.50 - 146.00	66.00 - 66.50	3.747	.320	115.96	4.485	.113	126.74
738	145.50 - 146.00	66.50 - 67.00	3.731	.325	142.95	4.276	.088	120.94
739	145.50 - 146.00	67.00 - 67.50	3.731	.325	171.71	4.215	.099	130.21
740	145.50 - 146.00	67.50 - 68.00	3.713	.333	203.77	4.181	.102	121.97
741	145.50 - 146.00	68.00 - 68.50	3.405	.000	233.36	3.892	.272	106.67
742	145.50 - 146.00	68.50 - 69.00	.000	.000	.00	3.738	.107	101.11
743	145.50 - 146.00	69.00 - 69.50	.000	.000	.00	3.537	.184	72.35
744	145.50 - 146.00	69.50 - 70.00	.000	.000	.00	3.529	.195	26.95
745	145.50 - 146.00	70.00 - 70.50	.000	.000	.00	3.399	.181	46.28
746	145.50 - 146.00	70.50 - 71.00	.000	.000	.00	3.411	.165	40.79
747	145.50 - 146.00	71.00 - 71.50	.000	.000	.00	3.356	.211	76.92
748	145.50 - 146.00	71.50 - 72.00	.000	.000	.00	3.321	.226	112.39
749	146.00 - 146.50	55.00 - 55.50	.000	.000	.00	4.704	.297	199.53
750	146.00 - 146.50	55.50 - 56.00	.000	.000	.00	4.877	.248	196.77
751	146.00 - 146.50	56.00 - 56.50	.000	.000	.00	4.962	.241	176.87
752	146.00 - 146.50	56.50 - 57.00	2.502	.000	232.00	5.184	.246	165.41
753	146.00 - 146.50	57.00 - 57.50	3.492	.298	232.03	5.299	.263	117.70
754	146.00 - 146.50	57.50 - 58.00	3.926	.312	226.41	5.325	.263	136.10
755	146.00 - 146.50	58.00 - 58.50	4.090	.218	199.49	5.399	.286	120.53
756	146.00 - 146.50	58.50 - 59.00	4.107	.201	169.25	5.417	.290	97.28
757	146.00 - 146.50	59.00 - 59.50	4.142	.181	144.35	5.423	.290	66.38
758	146.00 - 146.50	59.50 - 60.00	4.142	.181	110.93	5.425	.288	36.84
759	146.00 - 146.50	60.00 - 60.50	4.149	.174	49.95	5.443	.261	31.28
760	146.00 - 146.50	60.50 - 61.00	4.149	.174	87.97	5.430	.253	57.37
761	146.00 - 146.50	61.00 - 61.50	4.389	.416	103.06	5.426	.246	71.77
762	146.00 - 146.50	61.50 - 62.00	4.452	.406	92.77	5.374	.254	84.01
763	146.00 - 146.50	62.00 - 62.50	4.461	.398	54.14	5.329	.279	107.03
764	146.00 - 146.50	62.50 - 63.00	4.461	.398	131.24	5.301	.267	122.67
765	146.00 - 146.50	63.00 - 63.50	4.455	.403	151.71	5.138	.261	103.88
766	146.00 - 146.50	63.50 - 64.00	4.247	.187	123.34	4.951	.174	78.83
767	146.00 - 146.50	64.00 - 64.50	4.075	.114	83.10	4.860	.158	71.68
768	146.00 - 146.50	64.50 - 65.00	3.900	.256	39.32	4.755	.103	64.49
769	146.00 - 146.50	65.00 - 65.50	3.877	.266	66.43	4.633	.084	82.40
770	146.00 - 146.50	65.50 - 66.00	3.817	.288	87.58	4.568	.092	96.19

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
771	146.00 - 146.50	66.00 - 66.50	3.747	.320	107.96	4.485	.113	121.46
772	146.00 - 146.50	66.50 - 67.00	3.731	.325	136.28	4.276	.088	119.07
773	146.00 - 146.50	67.00 - 67.50	3.731	.325	166.12	4.215	.099	122.84
774	146.00 - 146.50	67.50 - 68.00	3.713	.333	198.79	4.188	.101	91.37
775	146.00 - 146.50	68.00 - 68.50	3.405	.000	228.05	3.906	.273	90.69
776	146.00 - 146.50	68.50 - 69.00	.000	.000	.00	3.775	.108	92.63
777	146.00 - 146.50	69.00 - 69.50	.000	.000	.00	3.546	.173	73.51
778	146.00 - 146.50	69.50 - 70.00	.000	.000	.00	3.529	.195	40.16
779	146.00 - 146.50	70.00 - 70.50	.000	.000	.00	3.399	.181	54.84
780	146.00 - 146.50	70.50 - 71.00	.000	.000	.00	3.399	.181	57.31
781	146.00 - 146.50	71.00 - 71.50	.000	.000	.00	3.356	.211	83.59
782	146.00 - 146.50	71.50 - 72.00	.000	.000	.00	3.321	.226	115.51
783	146.50 - 147.00	55.00 - 55.50	.000	.000	.00	4.812	.326	188.43
784	146.50 - 147.00	55.50 - 56.00	.000	.000	.00	4.975	.254	185.90
785	146.50 - 147.00	56.00 - 56.50	.000	.000	.00	5.045	.253	167.63
786	146.50 - 147.00	56.50 - 57.00	2.502	.000	224.72	5.238	.259	159.01
787	146.50 - 147.00	57.00 - 57.50	3.492	.296	230.65	5.340	.276	117.67
788	146.50 - 147.00	57.50 - 58.00	3.926	.312	222.30	5.365	.277	133.23
789	146.50 - 147.00	58.00 - 58.50	4.118	.201	192.08	5.473	.255	116.42
790	146.50 - 147.00	58.50 - 59.00	4.133	.189	163.27	5.489	.258	102.03
791	146.50 - 147.00	59.00 - 59.50	4.166	.166	138.82	5.495	.257	67.14
792	146.50 - 147.00	59.50 - 60.00	4.166	.166	108.53	5.497	.256	40.67
793	146.50 - 147.00	60.00 - 60.50	4.173	.160	77.33	5.473	.244	32.18
794	146.50 - 147.00	60.50 - 61.00	4.173	.160	81.02	5.440	.254	54.46
795	146.50 - 147.00	61.00 - 61.50	4.192	.147	65.29	5.458	.232	60.81
796	146.50 - 147.00	61.50 - 62.00	4.305	.215	53.71	5.391	.259	73.81
797	146.50 - 147.00	62.00 - 62.50	4.325	.197	75.26	5.346	.285	96.68
798	146.50 - 147.00	62.50 - 63.00	4.325	.197	116.73	5.318	.273	107.01
799	146.50 - 147.00	63.00 - 63.50	4.318	.203	134.04	5.154	.268	108.68
800	146.50 - 147.00	63.50 - 64.00	4.247	.187	119.52	4.951	.174	67.18
801	146.50 - 147.00	64.00 - 64.50	4.075	.114	75.49	4.859	.138	57.55
802	146.50 - 147.00	64.50 - 65.00	3.900	.256	22.98	4.755	.103	40.45
803	146.50 - 147.00	65.00 - 65.50	3.877	.266	56.99	4.633	.084	68.21
804	146.50 - 147.00	65.50 - 66.00	3.617	.288	77.67	4.568	.092	97.45
805	146.50 - 147.00	66.00 - 66.50	3.747	.320	100.93	4.489	.113	116.55

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
806	146.50 - 147.00	66.50 - 67.00	3.731	.325	130.65	4.283	.090	113.32
807	146.50 - 147.00	67.00 - 67.50	3.731	.325	161.45	4.221	.100	116.41
808	146.50 - 147.00	67.50 - 68.00	3.713	.333	194.64	4.189	.100	62.58
809	146.50 - 147.00	68.00 - 68.50	3.405	.000	223.55	3.907	.272	67.64
810	146.50 - 147.00	68.50 - 69.00	.000	.000	.00	3.779	.103	76.27
811	146.50 - 147.00	69.00 - 69.50	.000	.000	.00	3.546	.173	74.82
812	146.50 - 147.00	69.50 - 70.00	.000	.000	.00	3.529	.195	59.83
813	146.50 - 147.00	70.00 - 70.50	.000	.000	.00	3.399	.181	64.26
814	146.50 - 147.00	70.50 - 71.00	.000	.000	.00	3.399	.181	71.55
815	146.50 - 147.00	71.00 - 71.50	.000	.000	.00	3.356	.211	91.85
816	146.50 - 147.00	71.50 - 72.00	.000	.000	.00	3.321	.226	119.42
817	147.00 - 147.50	55.00 - 55.50	2.802	.300	252.48	5.043	.268	193.46
818	147.00 - 147.50	55.50 - 56.00	2.802	.300	230.29	5.140	.250	181.48
819	147.00 - 147.50	56.00 - 56.50	2.802	.300	211.43	5.191	.243	163.62
820	147.00 - 147.50	56.50 - 57.00	3.103	.001	201.98	5.341	.245	156.97
821	147.00 - 147.50	57.00 - 57.50	3.585	.245	210.97	5.430	.254	143.57
822	147.00 - 147.50	57.50 - 58.00	3.968	.283	211.72	5.450	.253	134.52
823	147.00 - 147.50	58.00 - 58.50	4.118	.201	186.60	5.527	.253	123.52
824	147.00 - 147.50	58.50 - 59.00	4.133	.189	157.35	5.542	.256	103.15
825	147.00 - 147.50	59.00 - 59.50	4.166	.166	132.05	5.547	.254	67.81
826	147.00 - 147.50	59.50 - 60.00	4.192	.154	105.22	5.542	.250	44.73
827	147.00 - 147.50	60.00 - 60.50	4.199	.147	82.67	5.505	.234	37.28
828	147.00 - 147.50	60.50 - 61.00	4.199	.147	73.14	5.471	.239	56.66
829	147.00 - 147.50	61.00 - 61.50	4.192	.147	41.62	5.370	.313	45.48
830	147.00 - 147.50	61.50 - 62.00	4.305	.215	64.99	5.388	.255	65.77
831	147.00 - 147.50	62.00 - 62.50	4.325	.197	93.64	5.343	.282	72.70
832	147.00 - 147.50	62.50 - 63.00	4.325	.197	120.86	5.314	.269	98.14
833	147.00 - 147.50	63.00 - 63.50	4.318	.203	133.79	5.142	.259	98.09
834	147.00 - 147.50	63.50 - 64.00	4.247	.187	114.49	4.951	.174	64.76
835	147.00 - 147.50	64.00 - 64.50	4.075	.114	71.20	4.860	.138	55.67
836	147.00 - 147.50	64.50 - 65.00	3.900	.256	36.43	4.756	.102	29.77
837	147.00 - 147.50	65.00 - 65.50	3.877	.266	47.56	4.636	.085	53.94
838	147.00 - 147.50	65.50 - 66.00	3.817	.280	68.18	4.572	.092	93.54
839	147.00 - 147.50	66.00 - 66.50	3.747	.320	95.15	4.490	.112	110.62
840	147.00 - 147.50	66.50 - 67.00	3.731	.325	126.21	4.284	.089	103.80

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
841	147.00 - 147.50	67.00 - 67.50	3.731	.325	157.77	4.222	.099	110.94
842	147.00 - 147.50	67.50 - 68.00	3.713	.333	191.34	4.189	.100	78.84
843	147.00 - 147.50	68.00 - 68.50	3.405	.000	219.88	3.907	.272	47.33
844	147.00 - 147.50	68.50 - 69.00	.000	.000	.00	3.779	.103	52.90
845	147.00 - 147.50	69.00 - 69.50	.000	.000	.00	3.588	.191	78.36
846	147.00 - 147.50	69.50 - 70.00	.000	.000	.00	3.572	.211	78.96
847	147.00 - 147.50	70.00 - 70.50	.000	.000	.00	3.458	.203	78.94
848	147.00 - 147.50	70.50 - 71.00	.000	.000	.00	3.399	.181	83.81
849	147.00 - 147.50	71.00 - 71.50	.000	.000	.00	3.356	.211	100.57
850	147.00 - 147.50	71.50 - 72.00	.000	.000	.00	3.321	.226	123.66
851	147.50 - 148.00	55.00 - 55.50	2.802	.300	239.39	5.146	.263	185.40
852	147.50 - 148.00	55.50 - 56.00	2.802	.300	215.86	5.225	.249	170.67
853	147.50 - 148.00	56.00 - 56.50	2.802	.300	195.61	5.269	.243	152.91
854	147.50 - 148.00	56.50 - 57.00	3.103	.001	189.37	5.404	.244	146.58
855	147.50 - 148.00	57.00 - 57.50	3.463	.116	193.85	5.489	.253	142.17
856	147.50 - 148.00	57.50 - 58.00	3.869	.242	192.88	5.507	.252	130.03
857	147.50 - 148.00	58.00 - 58.50	4.118	.201	181.44	5.445	.355	106.54
858	147.50 - 148.00	58.50 - 59.00	4.133	.189	151.71	5.456	.360	88.93
859	147.50 - 148.00	59.00 - 59.50	4.166	.166	124.98	5.460	.361	52.22
860	147.50 - 148.00	59.50 - 60.00	4.192	.154	95.54	5.454	.356	46.24
861	147.50 - 148.00	60.00 - 60.50	4.199	.147	63.41	5.419	.335	39.99
862	147.50 - 148.00	60.50 - 61.00	4.199	.147	63.82	5.389	.326	56.98
863	147.50 - 148.00	61.00 - 61.50	4.192	.147	33.01	5.378	.318	49.65
864	147.50 - 148.00	61.50 - 62.00	4.305	.215	50.77	5.397	.259	58.26
865	147.50 - 148.00	62.00 - 62.50	4.325	.197	97.75	5.351	.286	86.48
866	147.50 - 148.00	62.50 - 63.00	4.325	.197	123.02	5.319	.271	103.40
867	147.50 - 148.00	63.00 - 63.50	4.318	.203	132.82	5.147	.262	78.39
868	147.50 - 148.00	63.50 - 64.00	4.247	.187	108.92	4.933	.165	61.83
869	147.50 - 148.00	64.00 - 64.50	4.075	.114	60.34	4.860	.138	51.65
870	147.50 - 148.00	64.50 - 65.00	3.900	.256	43.12	4.756	.102	34.47
871	147.50 - 148.00	65.00 - 65.50	3.877	.266	32.10	4.638	.085	57.59
872	147.50 - 148.00	65.50 - 66.00	3.817	.288	60.15	4.574	.092	89.91
873	147.50 - 148.00	66.00 - 66.50	3.747	.320	91.03	4.490	.112	103.76
874	147.50 - 148.00	66.50 - 67.00	3.731	.325	123.09	4.284	.089	88.36
875	147.50 - 148.00	67.00 - 67.50	3.731	.325	155.13	4.222	.099	105.66

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
876	147.50 - 148.00	67.50 - 68.00	3.713	.333	188.93	4.196	.100	72.27
877	147.50 - 148.00	68.00 - 68.50	3.405	.000	217.06	3.919	.274	66.79
878	147.50 - 148.00	68.50 - 69.00	.000	.000	.00	3.812	.107	36.40
879	147.50 - 148.00	69.00 - 69.50	.000	.000	.00	3.588	.191	79.85
880	147.50 - 148.00	69.50 - 70.00	.000	.000	.00	3.572	.211	91.82
881	147.50 - 148.00	70.00 - 70.50	.000	.000	.00	3.458	.203	89.94
882	147.50 - 148.00	70.50 - 71.00	.000	.000	.00	3.399	.181	94.94
883	147.50 - 148.00	71.00 - 71.50	.000	.000	.00	3.356	.211	109.15
884	147.50 - 148.00	71.50 - 72.00	.000	.000	.00	3.321	.226	127.60
885	148.00 - 148.50	55.00 - 55.50	2.802	.300	227.04	5.138	.275	165.07
886	148.00 - 148.50	55.50 - 56.00	2.802	.300	202.08	5.197	.282	146.58
887	148.00 - 148.50	56.00 - 56.50	2.602	.300	160.28	5.232	.286	126.38
888	148.00 - 148.50	56.50 - 57.00	3.103	.001	176.65	5.335	.316	110.87
889	148.00 - 148.50	57.00 - 57.50	3.463	.116	184.66	5.407	.342	117.52
890	148.00 - 148.50	57.50 - 58.00	3.869	.242	186.41	5.422	.346	105.09
891	148.00 - 148.50	58.00 - 58.50	4.036	.166	165.50	5.474	.363	98.49
892	148.00 - 148.50	58.50 - 59.00	4.051	.157	136.65	5.485	.367	80.97
893	148.00 - 148.50	59.00 - 59.50	4.092	.117	110.09	5.489	.368	58.32
894	148.00 - 148.50	59.50 - 60.00	4.122	.096	80.58	5.474	.358	48.10
895	148.00 - 148.50	60.00 - 60.50	4.129	.089	35.61	5.439	.338	46.76
896	148.00 - 148.50	60.50 - 61.00	4.129	.089	51.43	5.399	.332	60.67
897	148.00 - 148.50	61.00 - 61.50	4.192	.147	29.92	5.380	.319	67.83
898	148.00 - 148.50	61.50 - 62.00	4.305	.215	64.74	5.399	.260	75.07
899	148.00 - 148.50	62.00 - 62.50	4.325	.197	98.56	5.353	.286	94.33
900	148.00 - 148.50	62.50 - 63.00	4.325	.197	123.25	5.321	.272	90.65
901	148.00 - 148.50	63.00 - 63.50	4.318	.203	131.86	5.148	.262	72.18
902	148.00 - 148.50	63.50 - 64.00	4.247	.187	104.74	4.931	.164	54.99
903	148.00 - 148.50	64.00 - 64.50	4.075	.114	42.35	4.858	.138	53.89
904	148.00 - 148.50	64.50 - 65.00	3.900	.256	34.21	4.754	.102	52.07
905	148.00 - 148.50	65.00 - 65.50	3.877	.266	19.35	4.636	.083	65.59
906	148.00 - 148.50	65.50 - 66.00	3.817	.288	56.28	4.574	.092	85.25
907	148.00 - 148.50	66.00 - 66.50	3.747	.320	88.99	4.494	.113	96.70
908	148.00 - 148.50	66.50 - 67.00	3.731	.325	121.37	4.289	.091	62.84
909	148.00 - 148.50	67.00 - 67.50	3.731	.325	153.56	4.228	.101	101.12
910	148.00 - 148.50	67.50 - 68.00	3.713	.333	187.41	4.198	.100	97.87

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	C(N)	R(N)
911	148.00 - 148.50	68.00 - 68.50	3.405	.000	215.10	3.922	.275	86.52
912	148.00 - 148.50	68.50 - 69.00	.000	.000	.00	3.812	.107	55.73
913	148.00 - 148.50	69.00 - 69.50	2.502	.000	303.93	3.588	.191	65.49
914	148.00 - 148.50	69.50 - 70.00	.000	.000	.00	3.572	.211	102.61
915	148.00 - 148.50	70.00 - 70.50	.000	.000	.00	3.458	.203	100.73
916	148.00 - 148.50	70.50 - 71.00	.000	.000	.00	3.399	.181	105.35
917	148.00 - 148.50	71.00 - 71.50	.000	.000	.00	3.356	.211	117.29
918	148.00 - 148.50	71.50 - 72.00	.000	.000	.00	3.321	.226	130.55
919	148.50 - 149.00	55.00 - 55.50	2.302	.300	215.55	5.188	.286	155.90
920	148.50 - 149.00	55.50 - 56.00	2.602	.300	189.08	5.241	.293	134.35
921	148.50 - 149.00	56.00 - 56.50	2.802	.300	165.59	5.275	.297	103.17
922	148.50 - 149.00	56.50 - 57.00	3.103	.001	163.73	5.370	.325	99.78
923	148.50 - 149.00	57.00 - 57.50	3.463	.116	174.69	5.438	.350	104.43
924	148.50 - 149.00	57.50 - 58.00	3.869	.242	179.85	5.452	.353	86.06
925	148.50 - 149.00	58.00 - 58.50	4.036	.166	160.94	5.493	.361	83.43
926	148.50 - 149.00	58.50 - 59.00	4.051	.157	132.34	5.504	.365	68.00
927	148.50 - 149.00	59.00 - 59.50	4.092	.117	103.16	5.507	.365	65.28
928	148.50 - 149.00	59.50 - 60.00	4.122	.096	68.78	5.490	.354	41.96
929	148.50 - 149.00	60.00 - 60.50	4.129	.089	51.87	5.444	.333	50.79
930	148.50 - 149.00	60.50 - 61.00	4.129	.089	38.44	5.395	.328	65.44
931	148.50 - 149.00	61.00 - 61.50	4.122	.085	32.13	5.383	.321	71.57
932	148.50 - 149.00	61.50 - 62.00	4.261	.181	61.45	5.402	.261	78.01
933	148.50 - 149.00	62.00 - 62.50	4.282	.164	93.32	5.352	.286	85.74
934	148.50 - 149.00	62.50 - 63.00	4.282	.164	117.41	5.319	.271	81.30
935	148.50 - 149.00	63.00 - 63.50	4.274	.169	126.05	5.146	.262	66.72
936	148.50 - 149.00	63.50 - 64.00	4.247	.187	103.65	4.931	.164	61.47
937	148.50 - 149.00	64.00 - 64.50	4.075	.114	51.47	4.859	.138	64.94
938	148.50 - 149.00	64.50 - 65.00	3.900	.256	22.22	4.756	.102	67.56
939	148.50 - 149.00	65.00 - 65.50	3.677	.266	29.90	4.638	.084	61.65
940	148.50 - 149.00	65.50 - 66.00	3.817	.288	57.93	4.577	.093	76.54
941	148.50 - 149.00	66.00 - 66.50	3.747	.320	89.16	4.495	.113	90.25
942	148.50 - 149.00	66.50 - 67.00	3.731	.325	121.05	4.290	.092	40.50
943	148.50 - 149.00	67.00 - 67.50	3.731	.325	153.02	4.229	.102	99.31
944	148.50 - 149.00	67.50 - 68.00	3.722	.328	185.44	4.199	.099	118.15
945	148.50 - 149.00	68.00 - 68.50	3.456	.000	217.16	3.923	.274	100.67

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
946	148.50 - 149.00	68.50 - 69.00	2.502	.000	270.73	3.816	.102	84.37
947	148.50 - 149.00	69.00 - 69.50	3.188	.521	308.04	3.588	.191	95.25
948	148.50 - 149.00	69.50 - 70.00	.000	.000	.00	3.572	.211	112.57
949	148.50 - 149.00	70.00 - 70.50	.000	.000	.00	3.458	.203	111.18
950	148.50 - 149.00	70.50 - 71.00	.000	.000	.00	3.399	.181	115.25
951	148.50 - 149.00	71.00 - 71.50	.000	.000	.00	3.356	.211	124.82
952	148.50 - 149.00	71.50 - 72.00	.000	.000	.00	3.321	.226	131.68
953	149.00 - 149.50	55.00 - 55.50	2.802	.300	205.08	5.230	.293	147.61
954	149.00 - 149.50	55.50 - 56.00	2.802	.300	177.04	5.277	.302	121.70
955	149.00 - 149.50	56.00 - 56.50	2.802	.300	151.70	5.309	.305	84.31
956	149.00 - 149.50	56.50 - 57.00	3.103	.001	150.55	5.397	.329	98.90
957	149.00 - 149.50	57.00 - 57.50	3.463	.116	163.34	5.462	.351	82.24
958	149.00 - 149.50	57.50 - 58.00	3.869	.242	172.60	5.474	.354	79.90
959	149.00 - 149.50	58.00 - 58.50	4.036	.166	156.76	5.499	.363	62.90
960	149.00 - 149.50	58.50 - 59.00	4.051	.157	129.28	5.509	.367	61.19
961	149.00 - 149.50	59.00 - 59.50	4.092	.117	98.96	5.512	.368	67.54
962	149.00 - 149.50	59.50 - 60.00	4.122	.096	46.18	5.492	.355	45.13
963	149.00 - 149.50	60.00 - 60.50	4.129	.089	55.16	5.445	.334	61.03
964	149.00 - 149.50	60.50 - 61.00	4.129	.089	22.63	5.396	.329	64.14
965	149.00 - 149.50	61.00 - 61.50	4.122	.085	28.10	5.377	.316	65.09
966	149.00 - 149.50	61.50 - 62.00	4.261	.181	47.80	5.393	.256	78.83
967	149.00 - 149.50	62.00 - 62.50	4.282	.164	89.55	5.342	.281	80.47
968	149.00 - 149.50	62.50 - 63.00	4.282	.164	115.38	5.310	.267	71.03
969	149.00 - 149.50	63.00 - 63.50	4.274	.169	126.21	5.145	.261	61.45
970	149.00 - 149.50	63.50 - 64.00	4.250	.186	105.49	4.930	.163	62.10
971	149.00 - 149.50	64.00 - 64.50	4.078	.112	42.58	4.860	.138	73.48
972	149.00 - 149.50	64.50 - 65.00	3.906	.255	34.95	4.757	.102	67.96
973	149.00 - 149.50	65.00 - 65.50	3.884	.263	32.41	4.639	.084	60.16
974	149.00 - 149.50	65.50 - 66.00	3.824	.285	63.51	4.577	.093	59.33
975	149.00 - 149.50	66.00 - 66.50	3.760	.318	91.94	4.495	.112	85.24
976	149.00 - 149.50	66.50 - 67.00	3.739	.322	121.94	4.291	.092	62.14
977	149.00 - 149.50	67.00 - 67.50	3.739	.322	152.70	4.230	.101	103.03
978	149.00 - 149.50	67.50 - 68.00	3.838	.371	197.54	4.199	.099	128.31
979	149.00 - 149.50	68.00 - 68.50	3.391	.427	180.36	3.923	.274	112.41
980	149.00 - 149.50	68.50 - 69.00	3.188	.521	274.00	3.816	.102	107.08

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
981	149.00 - 149.50	69.00 - 69.50	3.188	.521	297.89	3.664	.155	114.41
982	149.00 - 149.50	69.50 - 70.00	.000	.000	.00	3.600	.192	125.27
983	149.00 - 149.50	70.00 - 70.50	.000	.000	.00	3.493	.179	125.02
984	149.00 - 149.50	70.50 - 71.00	.000	.000	.00	3.399	.181	124.71
985	149.00 - 149.50	71.00 - 71.50	.000	.000	.00	3.356	.211	131.62
986	149.00 - 149.50	71.50 - 72.00	.000	.000	.00	3.321	.226	130.22
987	149.50 - 150.00	55.00 - 55.50	2.802	.300	195.78	5.241	.295	137.10
988	149.50 - 150.00	55.50 - 56.00	2.802	.300	166.18	5.292	.306	104.17
989	149.50 - 150.00	56.00 - 56.50	2.802	.300	138.87	5.323	.309	63.40
990	149.50 - 150.00	56.50 - 57.00	3.103	.001	137.18	5.403	.331	81.04
991	149.50 - 150.00	57.00 - 57.50	3.463	.116	149.91	5.468	.354	66.97
992	149.50 - 150.00	57.50 - 58.00	3.841	.250	160.83	5.479	.356	70.07
993	149.50 - 150.00	58.00 - 58.50	4.036	.166	152.49	5.499	.363	45.90
994	149.50 - 150.00	58.50 - 59.00	4.051	.157	127.43	5.509	.367	44.24
995	149.50 - 150.00	59.00 - 59.50	4.092	.117	99.94	5.511	.367	65.62
996	149.50 - 150.00	59.50 - 60.00	4.122	.096	67.01	5.490	.354	61.84
997	149.50 - 150.00	60.00 - 60.50	4.129	.089	50.06	5.443	.332	66.30
998	149.50 - 150.00	60.50 - 61.00	4.129	.089	37.44	5.393	.327	70.01
999	149.50 - 150.00	61.00 - 61.50	4.125	.083	38.61	5.374	.315	63.45
1000	149.50 - 150.00	61.50 - 62.00	4.264	.179	62.49	5.390	.255	67.25
1001	149.50 - 150.00	62.00 - 62.50	4.284	.162	78.13	5.339	.279	76.45
1002	149.50 - 150.00	62.50 - 63.00	4.284	.162	112.54	5.308	.266	68.39
1003	149.50 - 150.00	63.00 - 63.50	4.277	.167	127.12	5.144	.261	43.24
1004	149.50 - 150.00	63.50 - 64.00	4.255	.182	110.70	4.931	.164	52.64
1005	149.50 - 150.00	64.00 - 64.50	4.085	.110	61.73	4.861	.138	82.29
1006	149.50 - 150.00	64.50 - 65.00	3.915	.253	40.61	4.758	.102	75.51
1007	149.50 - 150.00	65.00 - 65.50	3.895	.258	47.64	4.641	.084	43.24
1008	149.50 - 150.00	65.50 - 66.00	3.836	.281	71.25	4.578	.092	39.44
1009	149.50 - 150.00	66.00 - 66.50	3.874	.352	105.34	4.495	.112	82.01
1010	149.50 - 150.00	66.50 - 67.00	3.854	.361	134.93	4.291	.092	84.64
1011	149.50 - 150.00	67.00 - 67.50	3.854	.361	165.21	4.230	.101	110.14
1012	149.50 - 150.00	67.50 - 68.00	3.638	.371	196.70	4.207	.098	135.23
1013	149.50 - 150.00	68.00 - 68.50	3.391	.427	178.06	3.936	.278	122.41
1014	149.50 - 150.00	68.50 - 69.00	3.188	.521	263.31	3.855	.100	127.92
1015	149.50 - 150.00	69.00 - 69.50	3.188	.521	288.09	3.664	.155	126.81

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1016	149.50 - 150.00	69.50 - 70.00	.000	.000	.00	3.600	.192	135.16
1017	149.50 - 150.00	70.00 - 70.50	.000	.000	.00	3.493	.179	134.98
1018	149.50 - 150.00	70.50 - 71.00	.000	.000	.00	3.399	.181	133.83
1019	149.50 - 150.00	71.00 - 71.50	.000	.000	.00	3.356	.211	137.69
1020	149.50 - 150.00	71.50 - 72.00	.000	.000	.00	3.321	.226	125.86
1021	150.00 - 150.50	55.00 - 55.50	2.802	.300	187.83	5.247	.297	126.82
1022	150.00 - 150.50	55.50 - 56.00	2.802	.300	156.74	5.296	.307	105.91
1023	150.00 - 150.50	56.00 - 56.50	2.802	.300	127.42	5.325	.310	71.18
1024	150.00 - 150.50	56.50 - 57.00	3.103	.001	123.87	5.397	.329	80.35
1025	150.00 - 150.50	57.00 - 57.50	3.463	.116	133.75	5.461	.351	56.85
1026	150.00 - 150.50	57.50 - 58.00	3.841	.250	147.91	5.472	.353	56.53
1027	150.00 - 150.50	58.00 - 58.50	4.021	.164	145.98	5.499	.363	41.88
1028	150.00 - 150.50	58.50 - 59.00	4.037	.155	125.17	5.509	.368	46.17
1029	150.00 - 150.50	59.00 - 59.50	4.078	.117	101.38	5.509	.366	68.80
1030	150.00 - 150.50	59.50 - 60.00	4.112	.094	74.32	5.488	.353	73.78
1031	150.00 - 150.50	60.00 - 60.50	4.116	.091	33.90	5.440	.331	79.23
1032	150.00 - 150.50	60.50 - 61.00	4.116	.091	42.12	5.389	.325	77.32
1033	150.00 - 150.50	61.00 - 61.50	4.128	.080	30.82	5.371	.312	68.22
1034	150.00 - 150.50	61.50 - 62.00	4.267	.176	66.98	5.385	.252	62.31
1035	150.00 - 150.50	62.00 - 62.50	4.286	.161	54.62	5.334	.276	71.43
1036	150.00 - 150.50	62.50 - 63.00	4.286	.161	111.01	5.303	.263	67.14
1037	150.00 - 150.50	63.00 - 63.50	4.282	.164	128.57	5.138	.258	48.69
1038	150.00 - 150.50	63.50 - 64.00	4.300	.215	122.34	4.930	.164	60.37
1039	150.00 - 150.50	64.00 - 64.50	4.156	.172	81.57	4.861	.139	86.53
1040	150.00 - 150.50	64.50 - 65.00	4.002	.298	31.98	4.761	.104	76.95
1041	150.00 - 150.50	65.00 - 65.50	3.982	.307	65.59	4.642	.086	29.26
1042	150.00 - 150.50	65.50 - 66.00	3.933	.326	86.27	4.577	.093	35.75
1043	150.00 - 150.50	66.00 - 66.50	3.874	.352	109.36	4.500	.112	82.77
1044	150.00 - 150.50	66.50 - 67.00	3.854	.361	136.76	4.298	.096	96.32
1045	150.00 - 150.50	67.00 - 67.50	3.854	.361	165.67	4.237	.103	117.48
1046	150.00 - 150.50	67.50 - 68.00	3.838	.371	196.18	4.207	.098	140.77
1047	150.00 - 150.50	68.00 - 68.50	3.391	.427	175.92	3.936	.278	129.89
1048	150.00 - 150.50	68.50 - 69.00	3.188	.521	252.96	3.855	.100	141.18
1049	150.00 - 150.50	69.00 - 69.50	3.188	.521	278.66	3.664	.155	138.56
1050	150.00 - 150.50	69.50 - 70.00	.000	.000	.00	3.600	.192	145.02

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1051	150.00 - 150.50	70.00 - 70.50	.000	.000	.00	3.493	.179	144.67
1052	150.00 - 150.50	70.50 - 71.00	.000	.000	.00	3.399	.181	142.67
1053	150.00 - 150.5	71.00 - 71.50	.000	.000	.00	3.356	.211	143.21
1054	150.00 - 150.50	71.50 - 72.00	.000	.000	.00	3.321	.226	119.46
1055	150.50 - 151.00	55.00 - 55.50	2.802	.300	131.40	5.253	.299	109.44
1056	150.50 - 151.00	55.50 - 56.00	2.802	.300	148.98	5.302	.309	100.27
1057	150.50 - 151.00	56.00 - 56.50	2.802	.300	117.74	5.326	.311	75.29
1058	150.50 - 151.00	56.50 - 57.00	3.103	.001	111.26	5.395	.329	67.76
1059	150.50 - 151.00	57.00 - 57.50	3.463	.116	114.73	5.458	.351	55.57
1060	150.50 - 151.00	57.50 - 58.00	3.841	.250	128.43	5.467	.352	46.41
1061	150.50 - 151.00	58.00 - 58.50	4.025	.161	137.93	5.492	.360	43.90
1062	150.50 - 151.00	58.50 - 59.00	4.040	.154	123.88	5.501	.365	59.05
1063	150.50 - 151.00	59.00 - 59.50	4.082	.115	102.68	5.502	.363	74.44
1064	150.50 - 151.00	59.50 - 60.00	4.116	.091	77.93	5.479	.348	73.58
1065	150.50 - 151.00	60.00 - 60.50	4.119	.088	49.46	5.429	.326	77.52
1066	150.50 - 151.00	60.50 - 61.00	4.119	.088	30.66	5.378	.318	78.61
1067	150.50 - 151.00	61.00 - 61.50	4.111	.088	29.77	5.367	.311	62.16
1068	150.50 - 151.00	61.50 - 62.00	4.252	.186	62.60	5.379	.250	71.28
1069	150.50 - 151.00	62.00 - 62.50	4.272	.170	78.28	5.328	.274	70.28
1070	150.50 - 151.00	62.50 - 63.00	4.272	.170	111.60	5.296	.260	64.73
1071	150.50 - 151.00	63.00 - 63.50	4.312	.206	133.94	5.137	.258	47.39
1072	150.50 - 151.00	63.50 - 64.00	4.300	.215	128.93	4.922	.159	62.92
1073	150.50 - 151.00	64.00 - 64.50	4.156	.172	92.42	4.862	.139	88.55
1074	150.50 - 151.00	64.50 - 65.00	4.002	.298	51.80	4.764	.103	74.12
1075	150.50 - 151.00	65.00 - 65.50	3.982	.307	74.89	4.646	.087	45.51
1076	150.50 - 151.00	65.50 - 66.00	3.933	.326	92.90	4.581	.093	53.90
1077	150.50 - 151.00	66.00 - 66.50	3.874	.352	113.14	4.500	.112	88.07
1078	150.50 - 151.00	66.50 - 67.00	3.854	.361	138.70	4.298	.096	103.15
1079	150.50 - 151.00	67.00 - 67.50	3.854	.361	166.28	4.237	.103	123.58
1080	150.50 - 151.00	67.50 - 68.00	3.838	.371	195.82	4.207	.098	145.74
1081	150.50 - 151.00	68.00 - 68.50	3.391	.427	173.84	3.936	.278	135.90
1082	150.50 - 151.00	68.50 - 69.00	3.188	.521	243.00	3.855	.100	151.63
1083	150.50 - 151.00	69.00 - 69.50	3.188	.521	269.65	3.664	.155	149.37
1084	150.50 - 151.00	69.50 - 70.00	.000	.000	.00	3.600	.192	154.73
1085	150.50 - 151.00	70.00 - 70.50	.000	.000	.00	3.493	.179	154.12

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	B(N)	R(N)
1086	150.50 - 151.00	70.50 - 71.00	.000	.000	.00	3.411	.165	152.38
1087	150.50 - 151.00	71.00 - 71.50	.000	.000	.00	3.370	.192	149.98
1088	150.50 - 151.00	71.50 - 72.00	.000	.000	.00	3.321	.226	113.66
1089	151.00 - 151.50	55.00 - 55.50	2.953	.149	188.45	5.257	.301	114.30
1090	151.00 - 151.50	55.50 - 56.00	2.953	.149	155.73	5.306	.311	90.11
1091	151.00 - 151.50	56.00 - 56.50	2.953	.149	122.63	5.328	.312	64.81
1092	151.00 - 151.50	56.50 - 57.00	3.152	.049	103.11	5.392	.329	45.78
1093	151.00 - 151.50	57.00 - 57.50	3.492	.087	96.01	5.452	.349	46.29
1094	151.00 - 151.50	57.50 - 58.00	3.849	.245	99.17	5.459	.349	40.53
1095	151.00 - 151.50	58.00 - 58.50	4.025	.161	126.18	5.487	.360	39.82
1096	151.00 - 151.50	58.50 - 59.00	4.040	.154	122.53	5.495	.363	55.46
1097	151.00 - 151.50	59.00 - 59.50	4.082	.115	101.33	5.495	.361	62.92
1098	151.00 - 151.50	59.50 - 60.00	4.116	.091	77.71	5.472	.346	74.31
1099	151.00 - 151.50	60.00 - 60.50	4.119	.088	56.12	5.420	.322	65.87
1100	151.00 - 151.50	60.50 - 61.00	4.119	.088	20.61	5.367	.314	71.41
1101	151.00 - 151.50	61.00 - 61.50	4.108	.090	30.39	5.355	.304	55.39
1102	151.00 - 151.50	61.50 - 62.00	4.249	.188	48.61	5.363	.243	62.97
1103	151.00 - 151.50	62.00 - 62.50	4.270	.171	91.94	5.310	.265	54.06
1104	151.00 - 151.50	62.50 - 63.00	4.270	.171	112.37	5.279	.252	64.93
1105	151.00 - 151.50	63.00 - 63.50	4.309	.208	133.98	5.134	.257	45.98
1106	151.00 - 151.50	63.50 - 64.00	4.284	.228	132.96	4.919	.158	50.55
1107	151.00 - 151.50	64.00 - 64.50	4.153	.174	102.53	4.861	.138	86.21
1108	151.00 - 151.50	64.50 - 65.00	3.997	.300	72.23	4.762	.103	74.98
1109	151.00 - 151.50	65.00 - 65.50	3.977	.310	79.88	4.644	.086	59.61
1110	151.00 - 151.50	65.50 - 66.00	3.928	.329	95.89	4.579	.092	66.76
1111	151.00 - 151.50	66.00 - 66.50	3.874	.352	116.05	4.500	.112	96.25
1112	151.00 - 151.50	66.50 - 67.00	3.854	.361	140.37	4.298	.096	108.82
1113	151.00 - 151.50	67.00 - 67.50	3.854	.361	166.79	4.230	.100	128.17
1114	151.00 - 151.50	67.50 - 68.00	3.838	.371	195.44	4.207	.098	150.22
1115	151.00 - 151.50	68.00 - 68.50	3.391	.427	171.73	3.936	.278	140.82
1116	151.00 - 151.50	68.50 - 69.00	3.188	.521	233.48	3.855	.100	160.05
1117	151.00 - 151.50	69.00 - 69.50	3.188	.521	261.11	3.670	.147	159.23
1118	151.00 - 151.50	69.50 - 70.00	.000	.000	.00	3.608	.182	164.53
1119	151.00 - 151.50	70.00 - 70.50	.000	.000	.00	3.502	.167	153.76
1120	151.00 - 151.50	70.50 - 71.00	.000	.000	.00	3.411	.165	160.84

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Ø(H)	R(H)	A(N)	Ø(N)	R(N)
1121	151.00 - 151.50	71.00 - 71.50	.000	.000	.00	3.370	.192	155.55
1122	151.00 - 151.50	71.50 - 72.00	.000	.000	.00	3.321	.226	112.06
1123	151.50 - 152.00	55.00 - 55.50	2.953	.149	184.06	5.266	.304	110.52
1124	151.50 - 152.00	55.50 - 56.00	2.953	.149	150.91	5.313	.313	71.24
1125	151.50 - 152.00	56.00 - 56.50	2.953	.149	116.96	5.335	.315	37.80
1126	151.50 - 152.00	56.50 - 57.00	3.152	.049	95.33	5.390	.328	34.91
1127	151.50 - 152.00	57.00 - 57.50	3.463	.116	75.78	5.439	.343	39.44
1128	151.50 - 152.00	57.50 - 58.00	3.841	.250	58.89	5.446	.343	44.16
1129	151.50 - 152.00	58.00 - 58.50	4.025	.161	111.97	5.488	.357	44.84
1130	151.50 - 152.00	58.50 - 59.00	4.040	.154	121.81	5.495	.360	36.42
1131	151.50 - 152.00	59.00 - 59.50	4.082	.115	97.45	5.496	.358	64.52
1132	151.50 - 152.00	59.50 - 60.00	4.116	.091	62.72	5.465	.344	62.09
1133	151.50 - 152.00	60.00 - 60.50	4.119	.088	62.18	5.409	.317	60.15
1134	151.50 - 152.00	60.50 - 61.00	4.119	.088	37.65	5.355	.308	65.44
1135	151.50 - 152.00	61.00 - 61.50	4.108	.090	44.51	5.342	.298	69.88
1136	151.50 - 152.00	61.50 - 62.00	4.249	.188	69.73	5.346	.237	61.50
1137	151.50 - 152.00	62.00 - 62.50	4.270	.171	98.24	5.292	.259	66.37
1138	151.50 - 152.00	62.50 - 63.00	4.270	.171	104.46	5.265	.247	67.84
1139	151.50 - 152.00	63.00 - 63.50	4.309	.208	131.36	5.122	.252	61.92
1140	151.50 - 152.00	63.50 - 64.00	4.281	.230	137.42	4.915	.157	78.84
1141	151.50 - 152.00	64.00 - 64.50	4.150	.176	109.44	4.861	.138	98.52
1142	151.50 - 152.00	64.50 - 65.00	3.992	.302	77.20	4.762	.103	89.52
1143	151.50 - 152.00	65.00 - 65.50	3.971	.314	73.83	4.643	.086	71.72
1144	151.50 - 152.00	65.50 - 66.00	3.921	.333	94.21	4.579	.092	81.86
1145	151.50 - 152.00	66.00 - 66.50	3.868	.355	117.32	4.498	.111	104.52
1146	151.50 - 152.00	66.50 - 67.00	3.854	.361	141.46	4.294	.094	113.68
1147	151.50 - 152.00	67.00 - 67.50	3.854	.361	166.91	4.223	.098	132.05
1148	151.50 - 152.00	67.50 - 68.00	3.838	.371	194.87	4.200	.095	153.44
1149	151.50 - 152.00	68.00 - 68.50	3.391	.427	169.54	3.924	.275	143.97
1150	151.50 - 152.00	68.50 - 69.00	3.188	.521	224.45	3.822	.091	163.63
1151	151.50 - 152.00	69.00 - 69.50	3.188	.521	253.07	3.704	.162	171.56
1152	151.50 - 152.00	69.50 - 70.00	.000	.000	.00	3.645	.197	177.81
1153	151.50 - 152.00	70.00 - 70.50	.000	.000	.00	3.550	.186	178.76
1154	151.50 - 152.00	70.50 - 71.00	.000	.000	.00	3.469	.188	176.36
1155	151.50 - 152.00	71.00 - 71.50	.000	.000	.00	3.432	.214	169.86

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1156	151.50 - 152.00	71.50 - 72.00	.000	.000	.00	3.321	.226	116.97
1157	152.00 - 152.50	55.00 - 55.50	2.953	.149	181.26	5.281	.308	108.35
1158	152.00 - 152.50	55.50 - 56.00	2.953	.149	148.16	5.327	.318	78.40
1159	152.00 - 152.50	56.00 - 56.50	2.953	.149	114.27	5.347	.319	47.16
1160	152.00 - 152.50	56.50 - 57.00	3.152	.049	92.22	5.395	.330	24.88
1161	152.00 - 152.50	57.00 - 57.50	3.463	.116	68.12	5.433	.339	36.57
1162	152.00 - 152.50	57.50 - 58.00	3.841	.250	28.87	5.439	.339	43.03
1163	152.00 - 152.50	58.00 - 58.50	4.021	.164	104.61	5.472	.350	48.12
1164	152.00 - 152.50	58.50 - 59.00	4.037	.155	123.26	5.480	.353	63.25
1165	152.00 - 152.50	59.00 - 59.50	4.040	.154	92.34	5.480	.351	71.21
1166	152.00 - 152.50	59.50 - 60.00	4.082	.115	35.63	5.448	.335	60.72
1167	152.00 - 152.50	60.00 - 60.50	4.085	.113	68.60	5.387	.307	50.60
1168	152.00 - 152.50	60.50 - 61.00	4.085	.113	56.64	5.331	.294	74.47
1169	152.00 - 152.50	61.00 - 61.50	4.108	.090	42.44	5.328	.291	76.00
1170	152.00 - 152.50	61.50 - 62.00	4.249	.188	86.41	5.327	.230	68.41
1171	152.00 - 152.50	62.00 - 62.50	4.270	.171	102.00	5.270	.250	82.46
1172	152.00 - 152.50	62.50 - 63.00	4.270	.171	76.77	5.243	.239	64.97
1173	152.00 - 152.50	63.00 - 63.50	4.309	.208	126.15	5.105	.245	32.52
1174	152.00 - 152.50	63.50 - 64.00	4.281	.230	141.31	4.899	.150	92.96
1175	152.00 - 152.50	64.00 - 64.50	4.150	.176	112.30	4.858	.138	108.23
1176	152.00 - 152.50	64.50 - 65.00	3.992	.302	63.36	4.761	.103	87.17
1177	152.00 - 152.50	65.00 - 65.50	3.971	.314	52.37	4.642	.086	85.59
1178	152.00 - 152.50	65.50 - 66.00	3.921	.333	89.93	4.578	.093	82.06
1179	152.00 - 152.50	66.00 - 66.50	3.861	.358	117.47	4.498	.111	111.48
1180	152.00 - 152.50	66.50 - 67.00	3.854	.361	141.64	4.294	.094	118.16
1181	152.00 - 152.50	67.00 - 67.50	3.854	.361	166.38	4.223	.098	135.53
1182	152.00 - 152.50	67.50 - 68.00	3.838	.371	193.93	4.198	.096	156.22
1183	152.00 - 152.50	68.00 - 68.50	3.391	.427	167.23	3.920	.274	146.96
1184	152.00 - 152.50	68.50 - 69.00	3.188	.521	215.98	3.810	.092	168.83
1185	152.00 - 152.50	69.00 - 69.50	3.188	.521	245.58	3.704	.162	179.62
1186	152.00 - 152.50	69.50 - 70.00	.000	.000	.00	3.645	.197	188.83
1187	152.00 - 152.50	70.00 - 70.50	.000	.000	.00	3.550	.186	192.23
1188	152.00 - 152.50	70.50 - 71.00	.000	.000	.00	3.469	.188	184.52
1189	152.00 - 152.50	71.00 - 71.50	.000	.000	.00	3.432	.214	177.09
1190	152.00 - 152.50	71.50 - 72.00	.000	.000	.00	3.321	.226	127.84

SEISMIC MAP OF ALASKA

SFID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1191	152.50 - 153.00	55.00 - 55.50	2.953	.149	179.94	5.286	.309	106.28
1192	152.50 - 153.00	55.50 - 56.00	2.953	.149	147.36	5.331	.319	75.51
1193	152.50 - 153.00	56.00 - 56.50	2.953	.149	114.42	5.350	.320	35.78
1194	152.50 - 153.00	56.50 - 57.00	3.152	.049	94.21	5.392	.329	28.11
1195	152.50 - 153.00	57.00 - 57.50	3.463	.116	75.60	5.422	.336	39.36
1196	152.50 - 153.00	57.50 - 58.00	3.841	.250	58.97	5.427	.335	55.31
1197	152.50 - 153.00	58.00 - 58.50	4.021	.164	113.71	5.456	.345	46.94
1198	152.50 - 153.00	58.50 - 59.00	4.033	.157	127.83	5.464	.348	68.32
1199	152.50 - 153.00	59.00 - 59.50	4.037	.155	100.02	5.463	.344	69.34
1200	152.50 - 153.00	59.50 - 60.00	4.078	.117	64.24	5.428	.328	50.36
1201	152.50 - 153.00	60.00 - 60.50	4.082	.115	80.16	5.364	.298	39.90
1202	152.50 - 153.00	60.50 - 61.00	4.082	.115	73.55	5.304	.283	74.26
1203	152.50 - 153.00	61.00 - 61.50	4.073	.114	64.33	5.302	.277	82.83
1204	152.50 - 153.00	61.50 - 62.00	4.223	.200	97.57	5.291	.214	95.18
1205	152.50 - 153.00	62.00 - 62.50	4.245	.184	103.50	5.230	.231	101.06
1206	152.50 - 153.00	62.50 - 63.00	4.245	.184	44.35	5.200	.219	89.11
1207	152.50 - 153.00	63.00 - 63.50	4.287	.218	121.75	5.065	.226	100.55
1208	152.50 - 153.00	63.50 - 64.00	4.281	.230	145.43	4.891	.146	104.45
1209	152.50 - 153.00	64.00 - 64.50	4.150	.176	114.77	4.855	.138	117.02
1210	152.50 - 153.00	64.50 - 65.00	3.992	.302	42.44	4.758	.102	86.46
1211	152.50 - 153.00	65.00 - 65.50	3.971	.314	32.17	4.640	.084	79.62
1212	152.50 - 153.00	65.50 - 66.00	3.921	.333	87.90	4.577	.092	98.02
1213	152.50 - 153.00	66.00 - 66.50	3.861	.358	117.60	4.499	.112	114.85
1214	152.50 - 153.00	66.50 - 67.00	3.854	.361	140.57	4.298	.096	121.33
1215	152.50 - 153.00	67.00 - 67.50	3.854	.361	164.88	4.228	.100	137.70
1216	152.50 - 153.00	67.50 - 68.00	3.838	.371	192.50	4.253	.100	164.77
1217	152.50 - 153.00	68.00 - 68.50	3.391	.427	164.78	3.932	.277	148.83
1218	152.50 - 153.00	68.50 - 69.00	3.188	.521	208.14	3.843	.103	174.51
1219	152.50 - 153.00	69.00 - 69.50	3.188	.521	238.71	3.648	.160	181.33
1220	152.50 - 153.00	69.50 - 70.00	.000	.000	.00	3.581	.200	193.80
1221	152.50 - 153.00	70.00 - 70.50	.000	.000	.00	3.469	.188	198.43
1222	152.50 - 153.00	70.50 - 71.00	.000	.000	.00	3.382	.175	188.71
1223	152.50 - 153.00	71.00 - 71.50	.000	.000	.00	3.337	.206	178.90
1224	152.50 - 153.00	71.50 - 72.00	.000	.000	.00	3.321	.226	142.41
1225	153.00 - 153.50	55.00 - 55.50	2.953	.149	179.94	5.299	.312	105.91

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
1226	153.00 - 153.50	55.50 - 56.00	2.953	.149	148.16	5.343	.322	74.42
1227	153.00 - 153.50	56.00 - 56.50	2.953	.149	116.80	5.358	.321	38.59
1228	153.00 - 153.50	56.50 - 57.00	3.152	.049	100.11	5.396	.329	35.84
1229	153.00 - 153.50	57.00 - 57.50	3.463	.116	92.73	5.421	.334	42.82
1230	153.00 - 153.50	57.50 - 58.00	3.841	.250	99.31	5.420	.333	57.85
1231	153.00 - 153.50	58.00 - 58.50	4.016	.167	131.39	5.439	.339	49.43
1232	153.00 - 153.50	58.50 - 59.00	4.029	.159	135.72	5.446	.341	71.98
1233	153.00 - 153.50	59.00 - 59.50	4.033	.157	113.85	5.444	.337	66.27
1234	153.00 - 153.50	59.50 - 60.00	4.075	.120	94.87	5.407	.319	51.25
1235	153.00 - 153.50	60.00 - 60.50	4.078	.117	94.73	5.338	.287	47.16
1236	153.00 - 153.50	60.50 - 61.00	4.078	.117	89.65	5.274	.269	76.91
1237	153.00 - 153.50	61.00 - 61.50	4.070	.115	86.45	5.272	.264	101.32
1238	153.00 - 153.50	61.50 - 62.00	4.163	.162	105.72	5.248	.200	113.05
1239	153.00 - 153.50	62.00 - 62.50	4.186	.149	106.57	5.182	.212	114.36
1240	153.00 - 153.50	62.50 - 63.00	4.186	.149	72.39	5.149	.200	111.73
1241	153.00 - 153.50	63.00 - 63.50	4.237	.189	123.39	5.016	.206	112.06
1242	153.00 - 153.50	63.50 - 64.00	4.260	.237	147.88	4.887	.147	110.29
1243	153.00 - 153.50	64.00 - 64.50	4.122	.186	118.78	4.854	.139	126.27
1244	153.00 - 153.50	64.50 - 65.00	3.950	.320	63.22	4.758	.104	112.85
1245	153.00 - 153.50	65.00 - 65.50	3.928	.329	51.10	4.642	.087	103.05
1246	153.00 - 153.50	65.50 - 66.00	3.921	.333	92.41	4.579	.095	94.93
1247	153.00 - 153.50	66.00 - 66.50	3.861	.358	116.92	4.532	.093	111.12
1248	153.00 - 153.50	66.50 - 67.00	3.854	.361	137.67	4.342	.075	127.16
1249	153.00 - 153.50	67.00 - 67.50	3.854	.361	162.15	4.276	.091	142.97
1250	153.00 - 153.50	67.50 - 68.00	3.838	.371	190.50	4.251	.100	164.12
1251	153.00 - 153.50	68.00 - 68.50	3.391	.427	162.24	3.929	.276	149.46
1252	153.00 - 153.50	68.50 - 69.00	3.188	.521	200.99	3.835	.103	175.94
1253	153.00 - 153.50	69.00 - 69.50	3.188	.521	232.50	3.642	.169	183.66
1254	153.00 - 153.50	69.50 - 70.00	.000	.000	.00	3.572	.211	197.13
1255	153.00 - 153.50	70.00 - 70.50	.000	.000	.00	3.469	.188	202.69
1256	153.00 - 153.50	70.50 - 71.00	.000	.000	.00	3.257	.175	191.49
1257	153.00 - 153.50	71.00 - 71.50	.000	.000	.00	3.195	.218	178.08
1258	153.00 - 153.50	71.50 - 72.00	.000	.000	.00	3.195	.218	145.65
1259	153.50 - 154.00	55.00 - 55.50	2.953	.149	181.03	5.300	.312	105.20
1260	153.50 - 154.00	55.50 - 56.00	2.953	.149	150.10	5.343	.322	73.90

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1261	153.50 - 154.00	56.00 - 56.50	2.953	.149	120.42	5.357	.322	32.71
1262	153.50 - 154.00	56.50 - 57.00	3.152	.049	107.46	5.392	.329	43.72
1263	153.50 - 154.00	57.00 - 57.50	3.342	.061	98.99	5.414	.333	44.93
1264	153.50 - 154.00	57.50 - 58.00	3.809	.264	126.49	5.412	.332	53.51
1265	153.50 - 154.00	58.00 - 58.50	3.999	.168	146.83	5.426	.333	61.40
1266	153.50 - 154.00	58.50 - 59.00	4.008	.161	143.99	5.430	.334	67.51
1267	153.50 - 154.00	59.00 - 59.50	4.013	.159	127.25	5.427	.329	57.99
1268	153.50 - 154.00	59.50 - 60.00	4.055	.126	114.99	5.388	.311	58.20
1269	153.50 - 154.00	60.00 - 60.50	4.059	.123	109.13	5.315	.276	52.05
1270	153.50 - 154.00	60.50 - 61.00	4.059	.123	104.43	5.247	.255	87.72
1271	153.50 - 154.00	61.00 - 61.50	4.067	.117	103.88	5.238	.248	112.35
1272	153.50 - 154.00	61.50 - 62.00	4.160	.165	119.16	5.193	.177	123.25
1273	153.50 - 154.00	62.00 - 62.50	4.183	.150	118.67	5.117	.184	122.95
1274	153.50 - 154.00	62.50 - 63.00	4.183	.150	106.18	5.080	.171	119.31
1275	153.50 - 154.00	63.00 - 63.50	4.235	.191	134.19	4.941	.172	113.30
1276	153.50 - 154.00	63.50 - 64.00	4.210	.208	147.97	4.877	.148	98.97
1277	153.50 - 154.00	64.00 - 64.50	4.042	.130	120.84	4.848	.146	135.77
1278	153.50 - 154.00	64.50 - 65.00	3.848	.279	80.27	4.758	.112	132.05
1279	153.50 - 154.00	65.00 - 65.50	3.830	.283	71.27	4.652	.078	120.65
1280	153.50 - 154.00	65.50 - 66.00	3.824	.285	91.87	4.591	.082	72.65
1281	153.50 - 154.00	66.00 - 66.50	3.861	.358	114.09	4.528	.094	88.56
1282	153.50 - 154.00	66.50 - 67.00	3.854	.361	132.22	4.338	.074	126.20
1283	153.50 - 154.00	67.00 - 67.50	3.854	.361	157.99	4.274	.091	137.16
1284	153.50 - 154.00	67.50 - 68.00	3.838	.371	187.93	4.243	.101	150.35
1285	153.50 - 154.00	68.00 - 68.50	3.391	.427	159.69	3.916	.274	148.63
1286	153.50 - 154.00	68.50 - 69.00	3.188	.521	194.61	3.797	.094	173.11
1287	153.50 - 154.00	69.00 - 69.50	3.188	.521	227.01	3.625	.175	184.36
1288	153.50 - 154.00	69.50 - 70.00	.000	.000	.00	3.551	.221	200.47
1289	153.50 - 154.00	70.00 - 70.50	.000	.000	.00	3.443	.199	207.80
1290	153.50 - 154.00	70.50 - 71.00	.000	.000	.00	3.257	.175	197.86
1291	153.50 - 154.00	71.00 - 71.50	.000	.000	.00	3.195	.218	186.52
1292	153.50 - 154.00	71.50 - 72.00	.000	.000	.00	2.981	.245	139.73
1293	154.00 - 154.50	55.00 - 55.50	2.953	.149	182.99	5.300	.312	103.05
1294	154.00 - 154.50	55.50 - 56.00	2.953	.149	152.70	5.341	.322	72.21
1295	154.00 - 154.50	56.00 - 56.50	2.953	.149	124.13	5.354	.322	40.66

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1296	154.00 - 154.50	56.50 - 57.00	3.152	.049	113.59	5.382	.327	39.34
1297	154.00 - 154.50	57.00 - 57.50	3.342	.061	110.13	5.402	.329	48.38
1298	154.00 - 154.50	57.50 - 58.00	3.809	.264	143.45	5.400	.327	68.71
1299	154.00 - 154.50	58.00 - 58.50	3.955	.181	155.39	5.419	.333	73.59
1300	154.00 - 154.50	58.50 - 59.00	3.965	.174	151.15	5.423	.333	65.97
1301	154.00 - 154.50	59.00 - 59.50	3.970	.171	138.27	5.420	.328	76.97
1302	154.00 - 154.50	59.50 - 60.00	4.015	.145	129.55	5.380	.310	75.82
1303	154.00 - 154.50	60.00 - 60.50	4.019	.142	121.87	5.304	.275	76.53
1304	154.00 - 154.50	60.50 - 61.00	4.019	.142	117.20	5.233	.251	89.45
1305	154.00 - 154.50	61.00 - 61.50	4.046	.126	118.00	5.207	.233	121.01
1306	154.00 - 154.50	61.50 - 62.00	4.142	.174	130.90	5.145	.160	131.40
1307	154.00 - 154.50	62.00 - 62.50	4.167	.158	128.38	5.061	.161	130.08
1308	154.00 - 154.50	62.50 - 63.00	4.167	.158	121.35	5.028	.150	108.31
1309	154.00 - 154.50	63.00 - 63.50	4.219	.201	139.80	4.884	.147	98.86
1310	154.00 - 154.50	63.50 - 64.00	4.207	.209	152.33	4.809	.117	120.02
1311	154.00 - 154.50	64.00 - 64.50	4.039	.131	130.63	4.783	.117	140.29
1312	154.00 - 154.50	64.50 - 65.00	3.848	.279	97.48	4.706	.096	139.84
1313	154.00 - 154.50	65.00 - 65.50	3.830	.283	89.85	4.594	.076	125.73
1314	154.00 - 154.50	65.50 - 66.00	3.824	.285	96.65	4.536	.089	97.72
1315	154.00 - 154.50	66.00 - 66.50	3.747	.320	96.18	4.512	.093	88.72
1316	154.00 - 154.50	66.50 - 67.00	3.739	.322	111.32	4.313	.072	123.53
1317	154.00 - 154.50	67.00 - 67.50	3.739	.322	138.01	4.251	.093	119.40
1318	154.00 - 154.50	67.50 - 68.00	3.838	.371	184.93	4.243	.101	153.89
1319	154.00 - 154.50	68.00 - 68.50	3.391	.427	157.26	3.916	.274	147.43
1320	154.00 - 154.50	68.50 - 69.00	3.188	.521	189.09	3.797	.094	172.43
1321	154.00 - 154.50	69.00 - 69.50	3.188	.521	222.28	3.603	.152	183.44
1322	154.00 - 154.50	69.50 - 70.00	.000	.000	.00	3.529	.195	203.58
1323	154.00 - 154.50	70.00 - 70.50	.000	.000	.00	3.411	.165	212.00
1324	154.00 - 154.50	70.50 - 71.00	.000	.000	.00	3.214	.194	205.45
1325	154.00 - 154.50	71.00 - 71.50	.000	.000	.00	3.140	.245	194.21
1326	154.00 - 154.50	71.50 - 72.00	.000	.000	.00	2.981	.245	154.95
1327	154.50 - 155.00	55.00 - 55.50	2.953	.149	185.66	5.302	.314	91.03
1328	154.50 - 155.00	55.50 - 56.00	2.953	.149	155.62	5.342	.323	66.93
1329	154.50 - 155.00	56.00 - 56.50	2.953	.149	127.14	5.354	.323	49.54
1330	154.50 - 155.00	56.50 - 57.00	3.103	.001	112.39	5.372	.325	53.23

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
1331	154.50 - 155.00	57.00 - 57.50	3.302	.101	108.15	5.389	.326	67.65
1332	154.50 - 155.00	57.50 - 58.00	3.599	.234	120.85	5.385	.324	76.40
1333	154.50 - 155.00	58.00 - 58.50	3.949	.186	160.14	5.407	.329	72.25
1334	154.50 - 155.00	58.50 - 59.00	3.960	.177	160.38	5.410	.329	56.36
1335	154.50 - 155.00	59.00 - 59.50	3.965	.174	151.34	5.406	.324	90.81
1336	154.50 - 155.00	59.50 - 60.00	4.011	.149	145.05	5.365	.304	93.69
1337	154.50 - 155.00	60.00 - 60.50	4.015	.145	136.96	5.283	.268	94.06
1338	154.50 - 155.00	60.50 - 61.00	4.015	.145	132.22	5.209	.242	109.61
1339	154.50 - 155.00	61.00 - 61.50	3.998	.157	128.76	5.190	.230	130.83
1340	154.50 - 155.00	61.50 - 62.00	4.101	.201	139.63	5.120	.158	140.10
1341	154.50 - 155.00	62.00 - 62.50	4.112	.192	129.96	5.031	.154	137.86
1342	154.50 - 155.00	62.50 - 63.00	4.112	.192	113.75	5.000	.144	133.54
1343	154.50 - 155.00	63.00 - 63.50	4.164	.241	133.27	4.857	.138	125.02
1344	154.50 - 155.00	63.50 - 64.00	4.188	.224	152.47	4.744	.090	132.56
1345	154.50 - 155.00	64.00 - 64.50	4.014	.149	136.62	4.716	.086	144.40
1346	154.50 - 155.00	64.50 - 65.00	3.842	.280	110.11	4.652	.078	143.94
1347	154.50 - 155.00	65.00 - 65.50	3.830	.283	101.69	4.567	.078	128.67
1348	154.50 - 155.00	65.50 - 66.00	3.824	.285	95.44	4.502	.092	108.83
1349	154.50 - 155.00	66.00 - 66.50	3.754	.319	84.22	4.444	.113	111.16
1350	154.50 - 155.00	66.50 - 67.00	3.747	.320	100.72	4.206	.089	112.69
1351	154.50 - 155.00	67.00 - 67.50	3.747	.320	132.11	4.123	.140	76.32
1352	154.50 - 155.00	67.50 - 68.00	3.722	.328	165.07	4.225	.107	143.95
1353	154.50 - 155.00	68.00 - 68.50	3.391	.427	155.12	3.916	.274	145.93
1354	154.50 - 155.00	68.50 - 69.00	3.138	.521	184.49	3.797	.094	171.22
1355	154.50 - 155.00	69.00 - 69.50	3.188	.521	218.38	3.587	.175	174.65
1356	154.50 - 155.00	69.50 - 70.00	.000	.000	.00	3.535	.194	198.43
1357	154.50 - 155.00	70.00 - 70.50	.000	.000	.00	3.411	.165	211.76
1358	154.50 - 155.00	70.50 - 71.00	.000	.000	.00	3.104	.146	204.86
1359	154.50 - 155.00	71.00 - 71.50	.000	.000	.00	3.013	.205	192.62
1360	154.50 - 155.00	71.50 - 72.00	.000	.000	.00	2.881	.298	161.35
1361	155.00 - 155.50	55.00 - 55.50	2.953	.149	189.00	5.292	.313	95.22
1362	155.00 - 155.50	55.50 - 56.00	2.953	.149	158.80	5.321	.318	63.48
1363	155.00 - 155.50	56.00 - 56.50	2.953	.149	129.35	5.333	.317	64.40
1364	155.00 - 155.50	56.50 - 57.00	3.103	.001	111.87	5.348	.317	72.31
1365	155.00 - 155.50	57.00 - 57.50	3.302	.101	98.69	5.365	.319	75.33

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1366	155.00 - 155.50	57.50 - 58.00	3.599	.234	101.07	5.360	.317	90.28
1367	155.00 - 155.50	58.00 - 58.50	3.758	.135	134.09	5.392	.325	80.30
1368	155.00 - 155.50	58.50 - 59.00	3.766	.127	148.44	5.393	.326	83.41
1369	155.00 - 155.50	59.00 - 59.50	3.774	.120	146.27	5.389	.320	101.20
1370	155.00 - 155.50	59.50 - 60.00	3.837	.087	144.67	5.345	.299	109.31
1371	155.00 - 155.50	60.00 - 60.50	3.844	.078	137.60	5.259	.262	114.80
1372	155.00 - 155.50	60.50 - 61.00	3.844	.078	132.90	5.179	.237	121.05
1373	155.00 - 155.50	61.00 - 61.50	3.994	.160	142.42	5.163	.221	139.85
1374	155.00 - 155.50	61.50 - 62.00	4.019	.142	140.26	5.079	.147	145.25
1375	155.00 - 155.50	62.00 - 62.50	4.031	.134	120.77	4.985	.138	139.68
1376	155.00 - 155.50	62.50 - 63.00	4.031	.134	77.62	4.951	.125	145.64
1377	155.00 - 155.50	63.00 - 63.50	4.101	.201	111.59	4.830	.129	142.43
1378	155.00 - 155.50	63.50 - 64.00	4.149	.253	148.12	4.728	.088	144.76
1379	155.00 - 155.50	64.00 - 64.50	3.964	.185	141.23	4.702	.085	153.69
1380	155.00 - 155.50	64.50 - 65.00	3.810	.291	119.60	4.636	.081	149.79
1381	155.00 - 155.50	65.00 - 65.50	3.793	.301	106.61	4.548	.082	115.92
1382	155.00 - 155.50	65.50 - 66.00	3.784	.307	86.11	4.479	.098	90.40
1383	155.00 - 155.50	66.00 - 66.50	3.754	.319	66.11	4.402	.122	123.17
1384	155.00 - 155.50	66.50 - 67.00	3.747	.320	87.74	4.135	.120	106.07
1385	155.00 - 155.50	67.00 - 67.50	3.747	.320	125.58	4.030	.198	45.11
1386	155.00 - 155.50	67.50 - 68.00	3.722	.328	162.12	4.128	.119	127.85
1387	155.00 - 155.50	68.00 - 68.50	3.391	.427	153.47	3.967	.193	151.78
1388	155.00 - 155.50	68.50 - 69.00	3.188	.521	180.88	3.717	.192	154.52
1389	155.00 - 155.50	69.00 - 69.50	3.188	.521	215.34	3.574	.176	171.61
1390	155.00 - 155.50	69.50 - 70.00	.000	.000	.00	3.518	.200	196.23
1391	155.00 - 155.50	70.00 - 70.50	.000	.000	.00	3.382	.175	208.69
1392	155.00 - 155.50	70.50 - 71.00	.000	.000	.00	3.104	.146	208.43
1393	155.00 - 155.50	71.00 - 71.50	.000	.000	.00	3.013	.205	199.77
1394	155.00 - 155.50	71.50 - 72.00	.000	.000	.00	2.621	.255	146.71
1395	155.50 - 156.00	55.00 - 55.50	2.953	.149	193.07	5.280	.307	82.82
1396	155.50 - 156.00	55.50 - 56.00	2.953	.149	162.45	5.298	.310	58.90
1397	155.50 - 156.00	56.00 - 56.50	2.953	.149	131.49	5.309	.309	69.68
1398	155.50 - 156.00	56.50 - 57.00	3.103	.001	110.20	5.325	.309	81.96
1399	155.50 - 156.00	57.00 - 57.50	3.103	.001	69.37	5.341	.311	81.31
1400	155.50 - 156.00	57.50 - 58.00	3.548	.245	59.27	5.336	.310	92.09

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1401	155.50 - 156.00	58.00 - 58.50	3.758	.135	120.99	5.365	.317	102.29
1402	155.50 - 156.00	58.50 - 59.00	3.766	.127	153.64	5.365	.317	108.90
1403	155.50 - 156.00	59.00 - 59.50	3.774	.120	157.11	5.360	.312	119.01
1404	155.50 - 156.00	59.50 - 60.00	3.837	.087	157.68	5.313	.290	98.37
1405	155.50 - 156.00	60.00 - 60.50	3.844	.078	150.93	5.206	.246	125.71
1406	155.50 - 156.00	60.50 - 61.00	3.844	.078	146.03	5.109	.228	110.91
1407	155.50 - 156.00	61.00 - 61.50	3.815	.096	139.59	5.130	.213	147.26
1408	155.50 - 156.00	61.50 - 62.00	3.850	.071	134.13	5.023	.162	143.80
1409	155.50 - 156.00	62.00 - 62.50	3.861	.059	105.28	4.917	.168	122.19
1410	155.50 - 156.00	62.50 - 63.00	3.861	.059	38.81	4.881	.152	146.18
1411	155.50 - 156.00	63.00 - 63.50	3.974	.177	72.01	4.809	.127	153.96
1412	155.50 - 156.00	63.50 - 64.00	4.085	.213	135.48	4.709	.087	153.89
1413	155.50 - 156.00	64.00 - 64.50	3.839	.079	132.60	4.686	.089	161.99
1414	155.50 - 156.00	64.50 - 65.00	3.664	.205	112.02	4.618	.086	155.10
1415	155.50 - 156.00	65.00 - 65.50	3.647	.208	95.53	4.530	.086	85.47
1416	155.50 - 156.00	65.50 - 66.00	3.637	.212	65.85	4.460	.106	105.17
1417	155.50 - 156.00	66.00 - 66.50	3.702	.339	41.79	4.388	.129	123.32
1418	155.50 - 156.00	66.50 - 67.00	3.691	.346	71.85	4.122	.121	105.11
1419	155.50 - 156.00	67.00 - 67.50	3.691	.346	116.43	4.060	.157	70.37
1420	155.50 - 156.00	67.50 - 68.00	3.722	.328	160.03	4.055	.159	120.85
1421	155.50 - 156.00	68.00 - 68.50	3.391	.427	152.51	3.952	.193	149.49
1422	155.50 - 156.00	68.50 - 69.00	3.188	.521	178.33	3.692	.178	150.88
1423	155.50 - 156.00	69.00 - 69.50	3.188	.521	213.20	3.561	.177	168.06
1424	155.50 - 156.00	69.50 - 70.00	.000	.000	.00	3.501	.206	193.75
1425	155.50 - 156.00	70.00 - 70.50	.000	.000	.00	3.350	.188	205.31
1426	155.50 - 156.00	70.50 - 71.00	.000	.000	.00	3.040	.175	204.05
1427	155.50 - 156.00	71.00 - 71.50	.000	.000	.00	3.013	.205	206.29
1428	155.50 - 156.00	71.50 - 72.00	.000	.000	.00	2.621	.255	160.07
1429	156.00 - 156.50	55.00 - 55.50	2.953	.149	197.99	5.268	.304	78.14
1430	156.00 - 156.50	55.50 - 56.00	2.953	.149	166.97	5.286	.306	84.26
1431	156.00 - 156.50	56.00 - 56.50	2.953	.149	134.70	5.298	.306	70.91
1432	156.00 - 156.50	56.50 - 57.00	3.103	.001	110.80	5.313	.305	82.39
1433	156.00 - 156.50	57.00 - 57.50	3.103	.001	63.48	5.330	.307	93.21
1434	156.00 - 156.50	57.50 - 58.00	3.532	.257	28.64	5.324	.306	86.83
1435	156.00 - 156.50	58.00 - 58.50	3.715	.154	110.40	5.344	.311	105.77

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1436	156.00 - 156.50	58.50 - 59.00	3.715	.154	157.52	5.338	.310	123.29
1437	156.00 - 156.50	59.00 - 59.50	3.715	.154	167.56	5.332	.304	132.24
1438	156.00 - 156.50	59.50 - 60.00	3.785	.135	171.54	5.279	.280	114.02
1439	156.00 - 156.50	60.00 - 60.50	3.793	.123	165.21	5.158	.232	134.73
1440	156.00 - 156.50	60.50 - 61.00	3.793	.123	159.93	5.048	.222	132.35
1441	156.00 - 156.50	61.00 - 61.50	3.815	.096	151.22	5.052	.196	149.19
1442	156.00 - 156.50	61.50 - 62.00	3.850	.071	143.32	4.879	.275	120.38
1443	156.00 - 156.50	62.00 - 62.50	3.861	.059	113.25	4.816	.244	79.44
1444	156.00 - 156.50	62.50 - 63.00	3.861	.059	65.29	4.779	.227	140.64
1445	156.00 - 156.50	63.00 - 63.50	3.974	.177	43.70	4.699	.193	152.33
1446	156.00 - 156.50	63.50 - 64.00	3.948	.197	119.13	4.691	.091	157.42
1447	156.00 - 156.50	64.00 - 64.50	3.780	.130	132.88	4.674	.098	168.79
1448	156.00 - 156.50	64.50 - 65.00	3.637	.212	115.88	4.613	.094	163.41
1449	156.00 - 156.50	65.00 - 65.50	3.627	.217	95.35	4.525	.091	120.69
1450	156.00 - 156.50	65.50 - 66.00	3.615	.225	57.68	4.456	.114	90.70
1451	156.00 - 156.50	66.00 - 66.50	3.517	.268	20.35	4.365	.140	109.88
1452	156.00 - 156.50	66.50 - 67.00	3.505	.270	52.51	4.093	.139	101.22
1453	156.00 - 156.50	67.00 - 67.50	3.505	.270	94.42	4.030	.173	86.35
1454	156.00 - 156.50	67.50 - 68.00	3.663	.368	155.58	4.060	.159	122.39
1455	156.00 - 156.50	68.00 - 68.50	3.309	.434	149.17	3.955	.194	147.27
1456	156.00 - 156.50	68.50 - 69.00	3.188	.521	176.88	3.692	.178	147.00
1457	156.00 - 156.50	69.00 - 69.50	3.188	.521	211.99	3.524	.163	162.46
1458	156.00 - 156.50	69.50 - 70.00	.000	.000	.00	3.457	.201	190.13
1459	156.00 - 156.50	70.00 - 70.50	.000	.000	.00	3.257	.175	196.65
1460	156.00 - 156.50	70.50 - 71.00	.000	.000	.00	2.954	.225	196.56
1461	156.00 - 156.50	71.00 - 71.50	.000	.000	.00	2.922	.255	200.72
1462	156.00 - 156.50	71.50 - 72.00	.000	.000	.00	2.621	.255	173.24
1463	156.50 - 157.00	55.00 - 55.50	3.041	.061	193.18	5.260	.303	57.70
1464	156.50 - 157.00	55.50 - 56.00	3.041	.061	170.89	5.275	.304	97.57
1465	156.50 - 157.00	56.00 - 56.50	3.041	.061	144.29	5.282	.299	72.22
1466	156.50 - 157.00	56.50 - 57.00	3.152	.049	119.08	5.279	.293	61.36
1467	156.50 - 157.00	57.00 - 57.50	3.152	.049	74.28	5.294	.292	101.15
1468	156.50 - 157.00	57.50 - 58.00	3.152	.049	40.22	5.286	.291	101.28
1469	156.50 - 157.00	58.00 - 58.50	3.611	.226	111.40	5.326	.307	93.55
1470	156.50 - 157.00	58.50 - 59.00	3.611	.226	154.33	5.323	.306	130.18

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1471	156.50 - 157.00	59.00 - 59.50	3.611	.226	167.80	5.317	.300	144.41
1472	156.50 - 157.00	59.50 - 60.00	3.715	.154	179.60	5.260	.275	136.16
1473	156.50 - 157.00	60.00 - 60.50	3.725	.144	174.22	5.127	.224	142.28
1474	156.50 - 157.00	60.50 - 61.00	3.725	.144	168.87	5.013	.208	146.83
1475	156.50 - 157.00	61.00 - 61.50	3.756	.151	162.31	4.985	.185	152.40
1476	156.50 - 157.00	61.50 - 62.00	3.765	.143	148.97	4.936	.128	98.96
1477	156.50 - 157.00	62.00 - 62.50	3.780	.130	121.70	4.862	.117	88.01
1478	156.50 - 157.00	62.50 - 63.00	3.780	.130	88.82	4.811	.115	157.51
1479	156.50 - 157.00	63.00 - 63.50	3.896	.242	70.36	4.702	.105	167.14
1480	156.50 - 157.00	63.50 - 64.00	3.948	.197	127.59	4.562	.132	128.58
1481	156.50 - 157.00	64.00 - 64.50	3.780	.130	137.99	4.546	.128	159.57
1482	156.50 - 157.00	64.50 - 65.00	3.637	.212	120.00	4.491	.120	159.15
1483	156.50 - 157.00	65.00 - 65.50	3.627	.217	96.89	4.398	.085	134.46
1484	156.50 - 157.00	65.50 - 66.00	3.615	.225	55.92	4.316	.071	103.27
1485	156.50 - 157.00	66.00 - 66.50	3.491	.275	14.97	4.362	.143	78.62
1486	156.50 - 157.00	66.50 - 67.00	3.475	.283	49.24	4.092	.140	96.59
1487	156.50 - 157.00	67.00 - 67.50	3.475	.283	91.79	4.032	.174	71.48
1488	156.50 - 157.00	67.50 - 68.00	3.475	.283	131.89	4.040	.173	118.84
1489	156.50 - 157.00	68.00 - 68.50	3.309	.434	149.47	3.932	.201	142.03
1490	156.50 - 157.00	68.50 - 69.00	3.188	.521	176.56	3.637	.151	136.98
1491	156.50 - 157.00	69.00 - 69.50	3.188	.521	211.72	3.524	.163	157.23
1492	156.50 - 157.00	69.50 - 70.00	.000	.000	.00	3.457	.201	185.61
1493	156.50 - 157.00	70.00 - 70.50	.000	.000	.00	3.257	.175	193.13
1494	156.50 - 157.00	70.50 - 71.00	.000	.000	.00	2.822	.122	184.42
1495	156.50 - 157.00	71.00 - 71.50	.000	.000	.00	2.822	.122	193.52
1496	156.50 - 157.00	71.50 - 72.00	.000	.000	.00	2.621	.255	186.21
1497	157.00 - 157.50	55.00 - 55.50	3.041	.061	191.47	5.237	.303	78.32
1498	157.00 - 157.50	55.50 - 56.00	3.041	.061	172.38	5.250	.301	101.92
1499	157.00 - 157.50	56.00 - 56.50	3.041	.061	149.16	5.255	.296	64.37
1500	157.00 - 157.50	56.50 - 57.00	3.152	.049	128.28	5.243	.282	54.59
1501	157.00 - 157.50	57.00 - 57.50	3.152	.049	92.20	5.257	.281	92.73
1502	157.00 - 157.50	57.50 - 58.00	3.152	.049	70.93	5.246	.277	119.65
1503	157.00 - 157.50	58.00 - 58.50	3.191	.089	94.43	5.281	.288	105.27
1504	157.00 - 157.50	58.50 - 59.00	3.152	.049	123.71	5.276	.288	114.72
1505	157.00 - 157.50	59.00 - 59.50	3.152	.049	146.23	5.264	.280	152.74

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	C(N)	R(N)
1506	157.00 - 157.50	59.50 - 60.00	3.313	.039	170.05	5.196	.251	116.03
1507	157.00 - 157.50	60.00 - 60.50	3.334	.049	168.46	5.033	.189	127.74
1508	157.00 - 157.50	60.50 - 61.00	3.334	.049	162.48	4.886	.183	148.09
1509	157.00 - 157.50	61.00 - 61.50	3.683	.168	168.94	4.954	.177	162.19
1510	157.00 - 157.50	61.50 - 62.00	3.692	.160	154.17	4.906	.137	140.41
1511	157.00 - 157.50	62.00 - 62.50	3.709	.150	131.08	4.829	.128	131.36
1512	157.00 - 157.50	62.50 - 63.00	3.709	.150	106.26	4.774	.130	168.09
1513	157.00 - 157.50	63.00 - 63.50	3.840	.259	104.27	4.662	.125	172.23
1514	157.00 - 157.50	63.50 - 64.00	3.896	.242	139.47	4.501	.091	86.77
1515	157.00 - 157.50	64.00 - 64.50	3.709	.199	139.07	4.479	.096	161.89
1516	157.00 - 157.50	64.50 - 65.00	3.535	.327	115.04	4.403	.093	162.80
1517	157.00 - 157.50	65.00 - 65.50	3.522	.331	91.69	4.307	.081	143.06
1518	157.00 - 157.50	65.50 - 66.00	3.522	.331	55.54	4.190	.081	106.56
1519	157.00 - 157.50	66.00 - 66.50	3.491	.275	25.58	4.217	.084	42.79
1520	157.00 - 157.50	66.50 - 67.00	3.475	.283	53.61	4.041	.169	90.22
1521	157.00 - 157.50	67.00 - 67.50	3.475	.283	94.35	4.018	.181	47.52
1522	157.00 - 157.50	67.50 - 68.00	3.457	.295	132.74	4.050	.165	117.57
1523	157.00 - 157.50	68.00 - 68.50	3.282	.447	148.99	3.946	.196	138.09
1524	157.00 - 157.50	68.50 - 69.00	3.188	.521	177.37	3.637	.151	130.78
1525	157.00 - 157.50	69.00 - 69.50	3.188	.521	212.39	3.458	.121	143.62
1526	157.00 - 157.50	69.50 - 70.00	.000	.000	.00	3.382	.168	170.80
1527	157.00 - 157.50	70.00 - 70.50	.000	.000	.00	3.295	.162	192.40
1528	157.00 - 157.50	70.50 - 71.00	.000	.000	.00	2.822	.122	182.70
1529	157.00 - 157.50	71.00 - 71.50	.000	.000	.00	2.822	.122	195.62
1530	157.00 - 157.50	71.50 - 72.00	.000	.000	.00	2.071	.000	131.22
1531	157.50 - 158.00	55.00 - 55.50	2.803	.000	168.17	5.158	.285	92.96
1532	157.50 - 158.00	55.50 - 56.00	2.803	.000	154.77	5.172	.282	93.41
1533	157.50 - 158.00	56.00 - 56.50	2.803	.000	136.86	5.176	.276	69.90
1534	157.50 - 158.00	56.50 - 57.00	2.803	.000	112.30	5.159	.259	71.27
1535	157.50 - 158.00	57.00 - 57.50	2.803	.000	86.90	5.173	.256	92.62
1536	157.50 - 158.00	57.50 - 58.00	2.803	.000	75.10	5.156	.254	126.84
1537	157.50 - 158.00	58.00 - 58.50	3.191	.089	115.83	5.239	.274	136.76
1538	157.50 - 158.00	58.50 - 59.00	3.152	.049	137.27	5.230	.272	146.28
1539	157.50 - 158.00	59.00 - 59.50	3.152	.049	157.43	5.218	.265	164.69
1540	157.50 - 158.00	59.50 - 60.00	3.313	.039	180.54	5.139	.233	154.37

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1541	157.50 - 158.00	60.00 - 60.50	3.334	.049	177.87	4.953	.163	151.95
1542	157.50 - 158.00	60.50 - 61.00	3.334	.049	171.52	4.807	.150	153.14
1543	157.50 - 158.00	61.00 - 61.50	3.145	.272	134.60	4.836	.162	164.85
1544	157.50 - 158.00	61.50 - 62.00	3.166	.286	116.44	4.790	.133	162.39
1545	157.50 - 158.00	62.00 - 62.50	3.201	.314	97.64	4.712	.126	157.27
1546	157.50 - 158.00	62.50 - 63.00	3.201	.314	81.41	4.661	.136	174.28
1547	157.50 - 158.00	63.00 - 63.50	3.535	.327	102.80	4.512	.132	169.76
1548	157.50 - 158.00	63.50 - 64.00	3.840	.259	149.46	4.444	.105	126.21
1549	157.50 - 158.00	64.00 - 64.50	3.637	.212	136.38	4.420	.113	162.22
1550	157.50 - 158.00	64.50 - 65.00	3.535	.327	119.29	4.354	.122	161.12
1551	157.50 - 158.00	65.00 - 65.50	3.522	.331	97.03	4.252	.110	144.73
1552	157.50 - 158.00	65.50 - 66.00	3.522	.331	65.22	4.125	.103	109.86
1553	157.50 - 158.00	66.00 - 66.50	3.350	.425	37.38	4.043	.117	58.72
1554	157.50 - 158.00	66.50 - 67.00	3.331	.428	54.71	3.814	.083	76.63
1555	157.50 - 158.00	67.00 - 67.50	3.331	.428	86.96	3.780	.093	56.70
1556	157.50 - 158.00	67.50 - 68.00	3.457	.295	136.76	4.033	.173	116.02
1557	157.50 - 158.00	68.00 - 68.50	3.282	.447	151.74	3.928	.198	127.45
1558	157.50 - 158.00	68.50 - 69.00	3.188	.521	179.30	3.604	.133	119.58
1559	157.50 - 158.00	69.00 - 69.50	3.188	.521	214.01	3.458	.121	137.86
1560	157.50 - 158.00	69.50 - 70.00	.000	.000	.00	3.382	.168	166.10
1561	157.50 - 158.00	70.00 - 70.50	.000	.000	.00	3.295	.162	189.32
1562	157.50 - 158.00	70.50 - 71.00	.000	.000	.00	2.822	.122	180.92
1563	157.50 - 158.00	71.00 - 71.50	.000	.000	.00	2.822	.122	197.09
1564	157.50 - 158.00	71.50 - 72.00	.000	.000	.00	2.071	.000	141.37
1565	158.00 - 158.50	55.00 - 55.50	2.803	.000	156.85	5.107	.276	92.51
1566	158.00 - 158.50	55.50 - 56.00	2.803	.000	148.93	5.121	.272	61.92
1567	158.00 - 158.50	56.00 - 56.50	2.803	.000	138.79	5.121	.264	74.17
1568	158.00 - 158.50	56.50 - 57.00	2.803	.000	122.72	5.092	.242	87.82
1569	158.00 - 158.50	57.00 - 57.50	2.803	.000	105.15	5.086	.235	113.82
1570	158.00 - 158.50	57.50 - 58.00	2.803	.000	97.53	5.056	.230	128.91
1571	158.00 - 158.50	58.00 - 58.50	2.803	.000	107.71	5.142	.248	149.76
1572	158.00 - 158.50	58.50 - 59.00	2.502	.000	101.41	5.128	.245	160.33
1573	158.00 - 158.50	59.00 - 59.50	2.502	.000	127.42	5.112	.236	172.20
1574	158.00 - 158.50	59.50 - 60.00	3.006	.258	193.29	5.000	.191	168.87
1575	158.00 - 158.50	60.00 - 60.50	3.055	.245	184.80	4.846	.146	162.68

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1576	158.00 - 158.50	60.50 - 61.00	3.055	.245	170.31	4.719	.133	141.99
1577	158.00 - 158.50	61.00 - 61.50	3.145	.272	142.69	4.755	.137	170.76
1578	158.00 - 158.50	61.50 - 62.00	3.166	.286	125.58	4.681	.132	172.24
1579	158.00 - 158.50	62.00 - 62.50	3.201	.314	109.11	4.614	.123	168.95
1580	158.00 - 158.50	62.50 - 63.00	3.201	.314	95.58	4.563	.128	172.59
1581	158.00 - 158.50	63.00 - 63.50	3.535	.327	122.04	4.410	.132	167.76
1582	158.00 - 158.50	63.50 - 64.00	3.535	.327	126.53	4.224	.123	138.90
1583	158.00 - 158.50	64.00 - 64.50	3.535	.327	130.16	4.196	.134	143.05
1584	158.00 - 158.50	64.50 - 65.00	3.522	.331	122.75	4.170	.161	137.76
1585	158.00 - 158.50	65.00 - 65.50	3.522	.331	104.06	4.049	.133	124.64
1586	158.00 - 158.50	65.50 - 66.00	3.522	.331	77.83	3.998	.144	108.57
1587	158.00 - 158.50	66.00 - 66.50	3.350	.425	53.09	3.976	.104	83.71
1588	158.00 - 158.50	66.50 - 67.00	3.331	.428	65.79	3.811	.095	82.36
1589	158.00 - 158.50	67.00 - 67.50	3.331	.428	93.98	3.781	.101	74.10
1590	158.00 - 158.50	67.50 - 68.00	3.309	.434	124.61	3.837	.100	96.11
1591	158.00 - 158.50	68.00 - 68.50	3.282	.447	155.75	3.629	.153	84.24
1592	158.00 - 158.50	68.50 - 69.00	3.188	.521	182.31	3.516	.123	102.47
1593	158.00 - 158.50	69.00 - 69.50	3.245	.470	220.37	3.458	.121	132.39
1594	158.00 - 158.50	69.50 - 70.00	.000	.000	.00	3.382	.168	161.97
1595	158.00 - 158.50	70.00 - 70.50	.000	.000	.00	3.295	.162	186.73
1596	158.00 - 158.50	70.50 - 71.00	.000	.000	.00	2.822	.122	179.24
1597	158.00 - 158.50	71.00 - 71.50	.000	.000	.00	2.822	.122	198.12
1598	158.00 - 158.50	71.50 - 72.00	.000	.000	.00	2.071	.000	151.57
1599	158.50 - 159.00	55.00 - 55.50	3.041	.061	165.38	5.136	.265	112.42
1600	158.50 - 159.00	55.50 - 56.00	3.041	.061	165.20	5.153	.257	93.90
1601	158.50 - 159.00	56.00 - 56.50	2.803	.000	137.95	5.147	.249	107.81
1602	158.50 - 159.00	56.50 - 57.00	2.803	.000	131.27	5.099	.233	101.68
1603	158.50 - 159.00	57.00 - 57.50	2.803	.000	121.64	5.067	.234	132.25
1604	158.50 - 159.00	57.50 - 58.00	2.803	.000	118.01	5.019	.240	114.88
1605	158.50 - 159.00	58.00 - 58.50	2.803	.000	127.02	5.032	.222	156.19
1606	158.50 - 159.00	58.50 - 59.00	2.502	.000	115.47	5.013	.220	167.45
1607	158.50 - 159.00	59.00 - 59.50	2.502	.000	138.87	4.990	.209	180.17
1608	158.50 - 159.00	59.50 - 60.00	2.803	.000	189.34	4.857	.166	178.72
1609	158.50 - 159.00	60.00 - 60.50	2.979	.000	203.67	4.708	.145	168.54
1610	158.50 - 159.00	60.50 - 61.00	2.979	.000	189.91	4.543	.175	89.24

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(F)	A(N)	C(N)	R(N)
1611	158.50 - 159.00	61.00 - 61.50	3.055	.245	156.75	4.686	.134	177.23
1612	158.50 - 159.00	61.50 - 62.00	3.092	.249	135.82	4.593	.139	180.48
1613	158.50 - 159.00	62.00 - 62.50	3.145	.272	119.14	4.527	.130	171.61
1614	158.50 - 159.00	62.50 - 63.00	3.145	.272	105.63	4.468	.135	153.67
1615	158.50 - 159.00	63.00 - 63.50	3.522	.331	136.27	4.288	.137	156.25
1616	158.50 - 159.00	63.50 - 64.00	3.535	.327	134.85	4.049	.114	132.70
1617	158.50 - 159.00	64.00 - 64.50	3.535	.327	133.43	4.046	.120	122.76
1618	158.50 - 159.00	64.50 - 65.00	3.522	.331	126.66	4.024	.140	107.51
1619	158.50 - 159.00	65.00 - 65.50	3.522	.331	112.00	3.968	.146	111.65
1620	158.50 - 159.00	65.50 - 66.00	3.522	.331	91.57	3.938	.157	110.58
1621	158.50 - 159.00	66.00 - 66.50	3.350	.425	68.47	3.862	.103	92.84
1622	158.50 - 159.00	66.50 - 67.00	3.331	.428	78.22	3.829	.114	87.61
1623	158.50 - 159.00	67.00 - 67.50	3.331	.428	102.66	3.816	.121	73.98
1624	158.50 - 159.00	67.50 - 68.00	3.331	.428	131.66	3.832	.109	90.34
1625	158.50 - 159.00	68.00 - 68.50	3.309	.434	161.10	3.626	.155	62.06
1626	158.50 - 159.00	68.50 - 69.00	3.245	.470	190.20	3.516	.123	93.00
1627	158.50 - 159.00	69.00 - 69.50	3.245	.470	222.83	3.458	.121	127.61
1628	158.50 - 159.00	69.50 - 70.00	.000	.000	.00	3.382	.168	158.59
1629	158.50 - 159.00	70.00 - 70.50	.000	.000	.00	3.295	.162	184.73
1630	158.50 - 159.00	70.50 - 71.00	.000	.000	.00	2.822	.122	177.78
1631	158.50 - 159.00	71.00 - 71.50	.000	.000	.00	2.822	.122	198.89
1632	158.50 - 159.00	71.50 - 72.00	.000	.000	.00	2.071	.000	161.80
1633	159.00 - 159.50	54.00 - 54.50	2.953	.149	157.70	4.967	.266	98.02
1634	159.00 - 159.50	54.50 - 55.00	3.103	.001	152.51	5.085	.263	81.80
1635	159.00 - 159.50	55.00 - 55.50	3.103	.001	148.13	5.093	.257	107.71
1636	159.00 - 159.50	55.50 - 56.00	3.103	.001	152.97	5.109	.252	115.84
1637	159.00 - 159.50	56.00 - 56.50	2.979	.000	151.28	5.093	.246	103.36
1638	159.00 - 159.50	56.50 - 57.00	2.979	.000	155.84	5.029	.234	113.58
1639	159.00 - 159.50	57.00 - 57.50	2.979	.000	155.61	4.976	.235	137.32
1640	159.00 - 159.50	57.50 - 58.00	2.803	.000	135.79	4.881	.238	139.00
1641	159.00 - 159.50	58.00 - 58.50	2.803	.000	144.93	4.979	.233	168.80
1642	159.00 - 159.50	58.50 - 59.00	2.502	.000	130.62	4.950	.239	166.45
1643	159.00 - 159.50	59.00 - 59.50	2.502	.000	151.70	4.917	.230	192.79
1644	159.00 - 159.50	59.50 - 60.00	2.803	.000	199.48	4.737	.191	188.89
1645	159.00 - 159.50	60.00 - 60.50	2.979	.000	211.67	4.545	.157	170.72

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1646	159.00 - 159.50	60.50 - 61.00	2.979	.000	198.41	4.409	.162	128.48
1647	159.00 - 159.50	61.00 - 61.50	2.979	.000	172.79	4.493	.185	172.65
1648	159.00 - 159.50	61.50 - 62.00	2.979	.000	147.04	4.389	.181	171.40
1649	159.00 - 159.50	62.00 - 62.50	2.979	.000	125.98	4.298	.150	145.97
1650	159.00 - 159.50	62.50 - 63.00	2.979	.000	111.13	4.218	.132	87.75
1651	159.00 - 159.50	63.00 - 63.50	3.309	.434	129.15	4.020	.187	119.49
1652	159.00 - 159.50	63.50 - 64.00	3.522	.331	138.03	3.889	.110	119.19
1653	159.00 - 159.50	64.00 - 64.50	3.522	.331	132.13	3.890	.117	97.46
1654	159.00 - 159.50	64.50 - 65.00	3.522	.331	128.88	3.878	.123	71.87
1655	159.00 - 159.50	65.00 - 65.50	3.522	.331	119.92	3.880	.118	93.91
1656	159.00 - 159.50	65.50 - 66.00	3.522	.331	105.33	3.855	.117	106.06
1657	159.00 - 159.50	66.00 - 66.50	3.379	.425	84.54	3.835	.112	100.03
1658	159.00 - 159.50	66.50 - 67.00	3.365	.424	92.86	3.827	.119	86.48
1659	159.00 - 159.50	67.00 - 67.50	3.365	.424	113.73	3.814	.126	53.31
1660	159.00 - 159.50	67.50 - 68.00	3.331	.428	138.75	3.816	.121	82.11
1661	159.00 - 159.50	68.00 - 68.50	3.309	.434	166.47	3.612	.154	41.52
1662	159.00 - 159.50	68.50 - 69.00	3.245	.470	194.18	3.510	.130	84.78
1663	159.00 - 159.50	69.00 - 69.50	3.245	.470	225.92	3.458	.121	123.98
1664	159.00 - 159.50	69.50 - 70.00	.000	.000	.00	3.382	.168	156.10
1665	159.00 - 159.50	70.00 - 70.50	.000	.000	.00	3.295	.162	183.38
1666	159.00 - 159.50	70.50 - 71.00	.000	.000	.00	2.822	.122	176.65
1667	159.00 - 159.50	71.00 - 71.50	.000	.000	.00	2.822	.122	199.55
1668	159.00 - 159.50	71.50 - 72.00	.000	.000	.00	2.071	.000	172.07
1669	159.50 - 160.00	54.00 - 54.50	3.041	.061	141.29	4.982	.264	82.52
1670	159.50 - 160.00	54.50 - 55.00	3.152	.049	135.06	5.042	.250	84.82
1671	159.50 - 160.00	55.00 - 55.50	3.152	.049	129.64	5.049	.247	75.33
1672	159.50 - 160.00	55.50 - 56.00	3.152	.049	138.64	5.061	.246	111.58
1673	159.50 - 160.00	56.00 - 56.50	3.104	.000	156.52	5.042	.239	101.81
1674	159.50 - 160.00	56.50 - 57.00	2.979	.000	156.17	4.948	.263	80.42
1675	159.50 - 160.00	57.00 - 57.50	2.979	.000	164.94	4.872	.252	136.34
1676	159.50 - 160.00	57.50 - 58.00	2.803	.000	150.47	4.715	.289	141.40
1677	159.50 - 160.00	58.00 - 58.50	2.803	.000	160.88	4.827	.231	168.02
1678	159.50 - 160.00	58.50 - 59.00	2.502	.000	146.52	4.784	.240	110.40
1679	159.50 - 160.00	59.00 - 59.50	2.502	.000	165.59	4.729	.228	188.54
1680	159.50 - 160.00	59.50 - 60.00	2.803	.000	210.56	4.546	.186	190.29

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1681	159.50 - 160.00	60.00 - 60.50	2.979	.000	220.61	4.213	.223	154.61
1682	159.50 - 160.00	60.50 - 61.00	2.979	.000	207.81	4.160	.200	146.01
1683	159.50 - 160.00	61.00 - 61.50	2.979	.000	181.15	4.321	.175	171.60
1684	159.50 - 160.00	61.50 - 62.00	2.979	.000	156.55	4.289	.176	172.94
1685	159.50 - 160.00	62.00 - 62.50	2.979	.000	136.04	4.173	.155	132.63
1686	159.50 - 160.00	62.50 - 63.00	2.979	.000	120.07	4.080	.149	43.87
1687	159.50 - 160.00	63.00 - 63.50	3.309	.434	134.01	3.975	.161	112.20
1688	159.50 - 160.00	63.50 - 64.00	3.350	.425	118.54	3.856	.138	116.77
1689	159.50 - 160.00	64.00 - 64.50	3.350	.425	108.43	3.864	.131	84.98
1690	159.50 - 160.00	64.50 - 65.00	3.350	.425	110.39	3.864	.131	43.31
1691	159.50 - 160.00	65.00 - 65.50	3.350	.425	109.29	3.867	.126	83.31
1692	159.50 - 160.00	65.50 - 66.00	3.350	.425	101.21	3.840	.127	106.38
1693	159.50 - 160.00	66.00 - 66.50	3.379	.425	97.93	3.827	.127	103.80
1694	159.50 - 160.00	66.50 - 67.00	3.365	.424	105.21	3.821	.130	83.90
1695	159.50 - 160.00	67.00 - 67.50	3.365	.424	123.31	3.808	.138	33.69
1696	159.50 - 160.00	67.50 - 68.00	3.331	.428	146.49	3.814	.126	77.21
1697	159.50 - 160.00	68.00 - 68.50	3.309	.434	172.46	3.608	.157	41.39
1698	159.50 - 160.00	68.50 - 69.00	3.245	.470	198.75	3.510	.130	79.94
1699	159.50 - 160.00	69.00 - 69.50	3.245	.470	229.56	3.451	.132	121.44
1700	159.50 - 160.00	69.50 - 70.00	.000	.000	.00	3.372	.184	154.23
1701	159.50 - 160.00	70.00 - 70.50	.000	.000	.00	3.280	.183	183.00
1702	159.50 - 160.00	70.50 - 71.00	.000	.000	.00	2.822	.122	175.94
1703	159.50 - 160.00	71.00 - 71.50	.000	.000	.00	2.822	.122	200.24
1704	159.50 - 160.00	71.50 - 72.00	.000	.000	.00	2.071	.000	182.37
1705	160.00 - 160.50	54.00 - 54.50	3.103	.001	127.36	5.005	.251	97.56
1706	160.00 - 160.50	54.50 - 55.00	3.152	.049	113.84	5.041	.253	99.63
1707	160.00 - 160.50	55.00 - 55.50	3.152	.049	104.16	5.046	.252	65.36
1708	160.00 - 160.50	55.50 - 56.00	3.152	.049	117.64	5.046	.249	89.77
1709	160.00 - 160.50	56.00 - 56.50	3.104	.000	143.57	5.023	.244	111.70
1710	160.00 - 160.50	56.50 - 57.00	2.979	.000	153.34	4.927	.263	116.40
1711	160.00 - 160.50	57.00 - 57.50	2.979	.000	170.33	4.824	.248	142.58
1712	160.00 - 160.50	57.50 - 58.00	2.803	.000	162.12	4.644	.281	148.89
1713	160.00 - 160.50	58.00 - 58.50	2.803	.000	174.72	4.642	.264	161.03
1714	160.00 - 160.50	58.50 - 59.00	2.502	.000	162.95	4.584	.261	145.01
1715	160.00 - 160.50	59.00 - 59.50	2.502	.000	180.28	4.506	.224	177.24

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1716	160.00 - 160.50	59.50 - 60.00	2.803	.000	222.39	4.335	.183	183.23
1717	160.00 - 160.50	60.00 - 60.50	2.979	.000	230.37	4.122	.210	168.41
1718	160.00 - 160.50	60.50 - 61.00	2.979	.000	218.00	4.045	.215	158.23
1719	160.00 - 160.50	61.00 - 61.50	3.104	.000	202.81	4.117	.194	166.89
1720	160.00 - 160.50	61.50 - 62.00	3.104	.000	178.03	4.049	.195	151.06
1721	160.00 - 160.50	62.00 - 62.50	3.104	.000	156.41	3.852	.157	106.85
1722	160.00 - 160.50	62.50 - 63.00	3.104	.000	137.33	3.830	.147	61.11
1723	160.00 - 160.50	63.00 - 63.50	3.350	.425	134.77	3.778	.126	99.76
1724	160.00 - 160.50	63.50 - 64.00	3.350	.425	109.50	3.841	.134	116.16
1725	160.00 - 160.50	64.00 - 64.50	3.350	.425	93.17	3.864	.131	80.26
1726	160.00 - 160.50	64.50 - 65.00	3.350	.425	103.55	3.864	.131	24.82
1727	160.00 - 160.50	65.00 - 65.50	3.350	.425	112.62	3.867	.126	78.74
1728	160.00 - 160.50	65.50 - 66.00	3.350	.425	110.65	3.840	.127	106.61
1729	160.00 - 160.50	66.00 - 66.50	3.331	.428	108.26	3.815	.134	104.15
1730	160.00 - 160.50	66.50 - 67.00	3.309	.434	114.24	3.808	.138	83.16
1731	160.00 - 160.50	67.00 - 67.50	3.309	.434	130.57	3.793	.148	36.96
1732	160.00 - 160.50	67.50 - 68.00	3.350	.425	154.30	3.808	.138	76.77
1733	160.00 - 160.50	68.00 - 68.50	3.331	.428	178.26	3.604	.160	29.32
1734	160.00 - 160.50	68.50 - 69.00	3.282	.447	204.71	3.504	.137	78.70
1735	160.00 - 160.50	69.00 - 69.50	3.245	.470	233.64	3.451	.132	121.30
1736	160.00 - 160.50	69.50 - 70.00	.000	.000	.00	3.372	.184	153.79
1737	160.00 - 160.50	70.00 - 70.50	.000	.000	.00	3.280	.183	182.87
1738	160.00 - 160.50	70.50 - 71.00	.000	.000	.00	2.780	.175	177.40
1739	160.00 - 160.50	71.00 - 71.50	.000	.000	.00	2.780	.175	209.93
1740	160.00 - 160.50	71.50 - 72.00	.000	.000	.00	2.074	.000	192.70
1741	160.50 - 161.00	54.00 - 54.50	3.103	.001	112.80	5.012	.253	92.37
1742	160.50 - 161.00	54.50 - 55.00	3.152	.049	92.15	5.070	.252	94.31
1743	160.50 - 161.00	55.00 - 55.50	3.152	.049	74.65	5.073	.251	62.83
1744	160.50 - 161.00	55.50 - 56.00	3.152	.049	95.22	5.072	.250	104.54
1745	160.50 - 161.00	56.00 - 56.50	3.104	.000	130.57	5.048	.246	84.03
1746	160.50 - 161.00	56.50 - 57.00	2.979	.000	149.21	4.967	.244	133.59
1747	160.50 - 161.00	57.00 - 57.50	2.979	.000	173.12	4.810	.247	150.07
1748	160.50 - 161.00	57.50 - 58.00	2.803	.000	171.30	4.614	.277	156.22
1749	160.50 - 161.00	58.00 - 58.50	2.803	.000	186.61	4.548	.254	169.02
1750	160.50 - 161.00	58.50 - 59.00	2.502	.000	179.76	4.474	.257	173.37

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1751	160.50 - 161.00	59.00 - 59.50	2.502	.000	195.61	4.377	.210	186.84
1752	160.50 - 161.00	59.50 - 60.00	2.803	.000	234.83	4.157	.182	184.12
1753	160.50 - 161.00	60.00 - 60.50	2.979	.000	240.84	3.822	.308	152.56
1754	160.50 - 161.00	60.50 - 61.00	2.979	.000	228.88	3.871	.216	161.44
1755	160.50 - 161.00	61.00 - 61.50	3.104	.000	209.42	3.999	.216	158.92
1756	160.50 - 161.00	61.50 - 62.00	3.104	.000	184.92	3.958	.192	132.17
1757	160.50 - 161.00	62.00 - 62.50	3.104	.000	162.58	3.781	.147	110.62
1758	160.50 - 161.00	62.50 - 63.00	3.104	.000	140.75	3.773	.141	92.20
1759	160.50 - 161.00	63.00 - 63.50	3.350	.425	132.85	3.734	.136	108.15
1760	160.50 - 161.00	63.50 - 64.00	3.350	.425	96.72	3.815	.142	117.06
1761	160.50 - 161.00	64.00 - 64.50	3.350	.425	70.11	3.841	.134	83.40
1762	160.50 - 161.00	64.50 - 65.00	3.350	.425	93.04	3.841	.134	42.27
1763	160.50 - 161.00	65.00 - 65.50	3.350	.425	114.23	3.844	.129	81.16
1764	160.50 - 161.00	65.50 - 66.00	3.350	.425	118.40	3.815	.134	104.96
1765	160.50 - 161.00	66.00 - 66.50	3.350	.425	118.70	3.815	.134	102.95
1766	160.50 - 161.00	66.50 - 67.00	3.331	.428	124.93	3.808	.138	84.45
1767	160.50 - 161.00	67.00 - 67.50	3.331	.428	139.43	3.793	.148	56.65
1768	160.50 - 161.00	67.50 - 68.00	3.282	.447	158.62	3.811	.149	81.85
1769	160.50 - 161.00	68.00 - 68.50	3.282	.447	182.59	3.620	.177	46.46
1770	160.50 - 161.00	68.50 - 69.00	3.282	.447	209.07	3.539	.161	86.20
1771	160.50 - 161.00	69.00 - 69.50	3.245	.470	238.06	3.451	.132	123.11
1772	160.50 - 161.00	69.50 - 70.00	.000	.000	.00	3.372	.184	154.42
1773	160.50 - 161.00	70.00 - 70.50	.000	.000	.00	3.280	.183	183.51
1774	160.50 - 161.00	70.50 - 71.00	.000	.000	.00	2.780	.175	176.78
1775	160.50 - 161.00	71.00 - 71.50	.000	.000	.00	2.780	.175	209.17
1776	160.50 - 161.00	71.50 - 72.00	.000	.000	.00	.000	.000	.00
1777	161.00 - 161.50	54.00 - 54.50	3.103	.001	101.12	5.045	.253	76.62
1778	161.00 - 161.50	54.50 - 55.00	3.152	.049	73.33	5.064	.253	65.94
1779	161.00 - 161.50	55.00 - 55.50	3.152	.049	42.23	5.067	.252	74.78
1780	161.00 - 161.50	55.50 - 56.00	3.152	.049	75.56	5.066	.251	87.14
1781	161.00 - 161.50	56.00 - 56.50	3.104	.000	120.59	5.041	.248	88.81
1782	161.00 - 161.50	56.50 - 57.00	2.979	.000	145.81	4.950	.242	131.14
1783	161.00 - 161.50	57.00 - 57.50	2.979	.000	174.86	4.783	.244	152.69
1784	161.00 - 161.50	57.50 - 58.00	2.803	.000	178.88	4.571	.274	161.07
1785	161.00 - 161.50	58.00 - 58.50	2.803	.000	197.00	4.507	.251	178.35

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1786	161.00 - 161.50	58.50 - 59.00	2.502	.000	196.86	4.424	.257	189.64
1787	161.00 - 161.50	59.00 - 59.50	2.502	.000	211.43	4.340	.227	201.55
1788	161.00 - 161.50	59.50 - 60.00	2.803	.000	247.77	4.106	.188	194.63
1789	161.00 - 161.50	60.00 - 60.50	2.979	.000	251.93	3.872	.239	181.46
1790	161.00 - 161.50	60.50 - 61.00	2.979	.000	240.36	3.794	.224	164.37
1791	161.00 - 161.50	61.00 - 61.50	3.104	.000	215.51	3.793	.214	134.16
1792	161.00 - 161.50	61.50 - 62.00	3.104	.000	190.89	3.744	.165	77.05
1793	161.00 - 161.50	62.00 - 62.50	3.104	.000	167.47	3.760	.156	113.44
1794	161.00 - 161.50	62.50 - 63.00	3.104	.000	142.93	3.759	.148	115.46
1795	161.00 - 161.50	63.00 - 63.50	3.350	.425	130.74	3.726	.139	119.08
1796	161.00 - 161.50	63.50 - 64.00	3.365	.424	85.27	3.779	.158	118.42
1797	161.00 - 161.50	64.00 - 64.50	3.365	.424	42.72	3.826	.147	92.86
1798	161.00 - 161.50	64.50 - 65.00	3.365	.424	82.89	3.826	.147	67.72
1799	161.00 - 161.50	65.00 - 65.50	3.365	.424	114.38	3.829	.141	88.30
1800	161.00 - 161.50	65.50 - 66.00	3.365	.424	123.20	3.798	.149	103.18
1801	161.00 - 161.50	66.00 - 66.50	3.350	.425	126.29	3.805	.144	98.49
1802	161.00 - 161.50	66.50 - 67.00	3.331	.428	132.85	3.798	.149	80.62
1803	161.00 - 161.50	67.00 - 67.50	3.331	.428	146.40	3.790	.154	69.99
1804	161.00 - 161.50	67.50 - 68.00	3.282	.447	165.20	3.811	.149	88.62
1805	161.00 - 161.50	68.00 - 68.50	3.282	.447	187.91	3.620	.177	70.24
1806	161.00 - 161.50	68.50 - 69.00	3.282	.447	213.39	3.539	.161	95.31
1807	161.00 - 161.50	69.00 - 69.50	3.245	.470	242.72	3.451	.132	126.53
1808	161.00 - 161.50	69.50 - 70.00	.000	.000	.00	3.372	.184	156.01
1809	161.00 - 161.50	70.00 - 70.50	.000	.000	.00	3.280	.183	184.90
1810	161.00 - 161.50	70.50 - 71.00	.000	.000	.00	2.780	.175	176.81
1811	161.00 - 161.50	71.00 - 71.50	.000	.000	.00	2.780	.175	208.98
1812	161.00 - 161.50	71.50 - 72.00	.000	.000	.00	.000	.000	.00
1813	161.50 - 162.00	54.00 - 54.50	3.103	.001	92.80	5.035	.252	70.99
1814	161.50 - 162.00	54.50 - 55.00	3.103	.001	61.63	5.089	.248	54.71
1815	161.50 - 162.00	55.00 - 55.50	3.103	.001	18.47	5.091	.248	98.45
1816	161.50 - 162.00	55.50 - 56.00	3.103	.001	63.92	5.090	.247	112.59
1817	161.50 - 162.00	56.00 - 56.50	2.979	.000	105.08	5.047	.242	63.28
1818	161.50 - 162.00	56.50 - 57.00	2.803	.003	129.12	4.948	.242	122.88
1819	161.50 - 162.00	57.00 - 57.50	2.803	.000	166.60	4.774	.246	154.35
1820	161.50 - 162.00	57.50 - 58.00	2.502	.000	172.79	4.543	.266	166.53

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1821	161.50 - 162.00	58.00 - 58.50	2.803	.000	206.44	4.457	.248	185.65
1822	161.50 - 162.00	58.50 - 59.00	2.502	.000	214.17	4.362	.257	199.49
1823	161.50 - 162.00	59.00 - 59.50	2.502	.000	227.64	4.310	.242	216.02
1824	161.50 - 162.00	59.50 - 60.00	2.502	.000	245.26	4.078	.203	209.78
1825	161.50 - 162.00	60.00 - 60.50	2.803	.000	267.37	3.781	.248	187.79
1826	161.50 - 162.00	60.50 - 61.00	2.803	.000	263.04	3.728	.233	169.22
1827	161.50 - 162.00	61.00 - 61.50	3.104	.000	221.11	3.698	.224	121.68
1828	161.50 - 162.00	61.50 - 62.00	3.104	.000	196.08	3.723	.185	42.44
1829	161.50 - 162.00	62.00 - 62.50	3.104	.000	171.48	3.752	.160	115.58
1830	161.50 - 162.00	62.50 - 63.00	3.201	.000	155.68	3.756	.154	131.49
1831	161.50 - 162.00	63.00 - 63.50	3.365	.424	130.31	3.723	.146	128.51
1832	161.50 - 162.00	63.50 - 64.00	3.365	.424	80.03	3.798	.157	124.81
1833	161.50 - 162.00	64.00 - 64.50	3.365	.424	24.11	3.841	.150	103.99
1834	161.50 - 162.00	64.50 - 65.00	3.365	.424	78.18	3.841	.150	86.93
1835	161.50 - 162.00	65.00 - 65.50	3.365	.424	115.04	3.844	.145	94.68
1836	161.50 - 162.00	65.50 - 66.00	3.365	.424	126.71	3.815	.150	102.53
1837	161.50 - 162.00	66.00 - 66.50	3.350	.425	131.37	3.794	.155	91.49
1838	161.50 - 162.00	66.50 - 67.00	3.331	.428	138.42	3.794	.155	68.04
1839	161.50 - 162.00	67.00 - 67.50	3.331	.428	151.71	3.787	.161	59.85
1840	161.50 - 162.00	67.50 - 68.00	3.282	.447	170.77	3.790	.154	91.98
1841	161.50 - 162.00	68.00 - 68.50	3.282	.447	192.71	3.588	.162	85.39
1842	161.50 - 162.00	68.50 - 69.00	3.282	.447	217.52	3.498	.145	101.74
1843	161.50 - 162.00	69.00 - 69.50	3.245	.470	247.54	3.451	.132	130.93
1844	161.50 - 162.00	69.50 - 70.00	.000	.000	.00	3.372	.184	158.34
1845	161.50 - 162.00	70.00 - 70.50	.000	.000	.00	3.280	.183	186.93
1846	161.50 - 162.00	70.50 - 71.00	.000	.000	.00	2.780	.175	177.41
1847	161.50 - 162.00	71.00 - 71.50	.000	.000	.00	2.780	.175	209.33
1848	161.50 - 162.00	71.50 - 72.00	.000	.000	.00	.000	.000	.00
1849	162.00 - 162.50	54.00 - 54.50	3.103	.001	86.27	5.035	.247	54.50
1850	162.00 - 162.50	54.50 - 55.00	3.103	.001	66.58	5.096	.240	67.22
1851	162.00 - 162.50	55.00 - 55.50	3.103	.001	39.90	5.097	.240	103.35
1852	162.00 - 162.50	55.50 - 56.00	3.103	.001	71.35	5.095	.240	123.42
1853	162.00 - 162.50	56.00 - 56.50	2.979	.000	107.30	5.039	.236	88.11
1854	162.00 - 162.50	56.50 - 57.00	2.803	.000	129.71	4.931	.237	94.48
1855	162.00 - 162.50	57.00 - 57.50	2.803	.000	166.36	4.743	.241	155.06

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(H)	A(N)	C(N)	R(N)
1856	162.00 - 162.50	57.50 - 58.00	2.502	.000	173.91	4.488	.260	170.62
1857	162.00 - 162.50	58.00 - 58.50	2.502	.000	208.17	4.417	.239	193.13
1858	162.00 - 162.50	58.50 - 59.00	.000	.000	.00	4.322	.255	209.82
1859	162.00 - 162.50	59.00 - 59.50	.000	.000	.00	4.258	.243	226.56
1860	162.00 - 162.50	59.50 - 60.00	.000	.000	.00	4.034	.228	224.20
1861	162.00 - 162.50	60.00 - 60.50	.000	.000	.00	3.656	.275	189.76
1862	162.00 - 162.50	60.50 - 61.00	.000	.000	.00	3.605	.248	167.78
1863	162.00 - 162.50	61.00 - 61.50	2.979	.000	225.04	3.632	.228	126.28
1864	162.00 - 162.50	61.50 - 62.00	2.979	.000	196.10	3.681	.200	74.48
1865	162.00 - 162.50	62.00 - 62.50	2.979	.000	167.13	3.706	.175	122.33
1866	162.00 - 162.50	62.50 - 63.00	3.104	.000	150.21	3.731	.169	141.20
1867	162.00 - 162.50	63.00 - 63.50	3.350	.425	133.19	3.728	.155	136.78
1868	162.00 - 162.50	63.50 - 64.00	3.365	.424	85.34	3.795	.164	128.50
1869	162.00 - 162.50	64.00 - 64.50	3.365	.424	42.72	3.823	.153	107.64
1870	162.00 - 162.50	64.50 - 65.00	3.365	.424	83.11	3.823	.153	91.07
1871	162.00 - 162.50	65.00 - 65.50	3.365	.424	116.62	3.826	.147	90.94
1872	162.00 - 162.50	65.50 - 66.00	3.365	.424	128.46	3.794	.155	97.03
1873	162.00 - 162.50	66.00 - 66.50	3.350	.425	133.65	3.794	.155	84.81
1874	162.00 - 162.50	66.50 - 67.00	3.331	.428	141.26	3.794	.155	45.98
1875	162.00 - 162.50	67.00 - 67.50	3.331	.428	155.04	3.787	.161	41.90
1876	162.00 - 162.50	67.50 - 68.00	3.282	.447	175.01	3.787	.161	95.58
1877	162.00 - 162.50	68.00 - 68.50	3.282	.447	196.81	3.584	.167	96.57
1878	162.00 - 162.50	68.50 - 69.00	3.282	.447	221.35	3.491	.154	109.84
1879	162.00 - 162.50	69.00 - 69.50	3.245	.470	252.43	3.443	.144	134.88
1880	162.00 - 162.50	69.50 - 70.00	.000	.000	.00	3.372	.184	161.19
1881	162.00 - 162.50	70.00 - 70.50	.000	.000	.00	3.280	.183	189.54
1882	162.00 - 162.50	70.50 - 71.00	.000	.000	.00	2.780	.175	178.54
1883	162.00 - 162.50	71.00 - 71.50	.000	.000	.00	2.780	.175	210.19
1884	162.00 - 162.50	71.50 - 72.00	.000	.000	.00	.000	.000	.00
1885	162.50 - 163.00	54.00 - 54.50	3.103	.001	77.68	5.051	.241	49.04
1886	162.50 - 163.00	54.50 - 55.00	3.103	.001	74.54	5.064	.245	49.44
1887	162.50 - 163.00	55.00 - 55.50	3.103	.001	67.46	5.063	.245	98.20
1888	162.50 - 163.00	55.50 - 56.00	3.103	.001	87.57	5.060	.245	124.79
1889	162.50 - 163.00	56.00 - 56.50	2.979	.000	114.60	5.008	.229	125.45
1890	162.50 - 163.00	56.50 - 57.00	2.803	.000	133.49	4.889	.251	131.85

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	C(N)	R(N)
1891	162.50 - 163.00	57.00 - 57.50	2.803	.000	168.51	4.644	.269	152.23
1892	162.50 - 163.00	57.50 - 58.00	2.502	.000	177.21	4.424	.251	177.34
1893	162.50 - 163.00	58.00 - 58.50	2.502	.000	210.94	4.327	.238	197.28
1894	162.50 - 163.00	58.50 - 59.00	.000	.000	.00	4.254	.280	219.39
1895	162.50 - 163.00	59.00 - 59.50	.000	.000	.00	4.168	.278	236.72
1896	162.50 - 163.00	59.50 - 60.00	.000	.000	.00	3.904	.258	232.38
1897	162.50 - 163.00	60.00 - 60.50	.000	.000	.00	3.473	.247	187.42
1898	162.50 - 163.00	60.50 - 61.00	.000	.000	.00	3.387	.198	158.47
1899	162.50 - 163.00	61.00 - 61.50	2.803	.000	219.88	3.564	.269	140.82
1900	162.50 - 163.00	61.50 - 62.00	2.803	.000	187.22	3.645	.233	115.98
1901	162.50 - 163.00	62.00 - 62.50	2.803	.000	154.98	3.675	.200	137.73
1902	162.50 - 163.00	62.50 - 63.00	2.979	.000	141.29	3.698	.200	149.31
1903	162.50 - 163.00	63.00 - 63.50	3.309	.434	136.75	3.706	.175	141.46
1904	162.50 - 163.00	63.50 - 64.00	3.350	.425	96.94	3.779	.175	129.46
1905	162.50 - 163.00	64.00 - 64.50	3.350	.425	69.95	3.816	.158	106.45
1906	162.50 - 163.00	64.50 - 65.00	3.350	.425	93.22	3.816	.158	83.07
1907	162.50 - 163.00	65.00 - 65.50	3.350	.425	117.89	3.819	.152	78.56
1908	162.50 - 163.00	65.50 - 66.00	3.350	.425	127.40	3.787	.161	90.34
1909	162.50 - 163.00	66.00 - 66.50	3.350	.425	132.75	3.772	.163	80.07
1910	162.50 - 163.00	66.50 - 67.00	3.331	.428	141.00	3.772	.163	28.07
1911	162.50 - 163.00	67.00 - 67.50	3.331	.428	156.16	3.763	.169	58.21
1912	162.50 - 163.00	67.50 - 68.00	3.282	.447	177.71	3.787	.161	101.20
1913	162.50 - 163.00	68.00 - 68.50	3.282	.447	200.09	3.584	.167	103.52
1914	162.50 - 163.00	68.50 - 69.00	3.282	.447	224.80	3.491	.154	115.99
1915	162.50 - 163.00	69.00 - 69.50	3.245	.470	257.34	3.435	.157	138.47
1916	162.50 - 163.00	69.50 - 70.00	.000	.000	.00	3.372	.184	164.35
1917	162.50 - 163.00	70.00 - 70.50	.000	.000	.00	3.280	.183	192.62
1918	162.50 - 163.00	70.50 - 71.00	.000	.000	.00	2.780	.175	180.13
1919	162.50 - 163.00	71.00 - 71.50	.000	.000	.00	2.780	.175	211.53
1920	162.50 - 163.00	71.50 - 72.00	.000	.000	.00	.000	.000	.00
1921	163.00 - 163.50	54.00 - 54.50	3.103	.001	62.82	5.028	.242	34.95
1922	163.00 - 163.50	54.50 - 55.00	3.103	.001	73.88	5.083	.246	56.10
1923	163.00 - 163.50	55.00 - 55.50	3.103	.001	84.91	5.081	.246	99.49
1924	163.00 - 163.50	55.50 - 56.00	3.103	.001	103.21	5.076	.245	130.14
1925	163.00 - 163.50	56.00 - 56.50	2.979	.000	124.24	5.004	.224	143.96

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1926	163.00 - 163.50	56.50 - 57.00	2.803	.000	139.60	4.877	.246	153.41
1927	163.00 - 163.50	57.00 - 57.50	2.803	.000	172.67	4.623	.266	161.79
1928	163.00 - 163.50	57.50 - 58.00	2.502	.000	182.58	4.372	.258	182.07
1929	163.00 - 163.50	58.00 - 58.50	2.502	.000	215.48	4.161	.220	191.82
1930	163.00 - 163.50	58.50 - 59.00	.000	.000	.00	4.052	.258	212.51
1931	163.00 - 163.50	59.00 - 59.50	.000	.000	.00	3.871	.228	217.77
1932	163.00 - 163.50	59.50 - 60.00	.000	.000	.00	3.564	.226	218.51
1933	163.00 - 163.50	60.00 - 60.50	.000	.000	.00	3.152	.175	172.89
1934	163.00 - 163.50	60.50 - 61.00	.000	.000	.00	3.013	.154	132.61
1935	163.00 - 163.50	61.00 - 61.50	2.803	.000	218.63	3.356	.211	141.91
1936	163.00 - 163.50	61.50 - 62.00	2.803	.000	186.09	3.587	.245	145.77
1937	163.00 - 163.50	62.00 - 62.50	2.803	.000	154.25	3.622	.208	152.01
1938	163.00 - 163.50	62.50 - 63.00	2.979	.000	141.27	3.650	.202	155.02
1939	163.00 - 163.50	63.00 - 63.50	3.104	.000	120.88	3.657	.180	141.67
1940	163.00 - 163.50	63.50 - 64.00	3.309	.434	107.37	3.758	.198	128.70
1941	163.00 - 163.50	64.00 - 64.50	3.309	.434	89.70	3.798	.175	100.28
1942	163.00 - 163.50	64.50 - 65.00	3.309	.434	101.63	3.798	.175	62.20
1943	163.00 - 163.50	65.00 - 65.50	3.309	.434	117.62	3.801	.168	56.31
1944	163.00 - 163.50	65.50 - 66.00	3.309	.434	123.60	3.783	.168	82.34
1945	163.00 - 163.50	66.00 - 66.50	3.350	.425	128.18	3.763	.169	82.05
1946	163.00 - 163.50	66.50 - 67.00	3.331	.428	137.34	3.763	.169	45.37
1947	163.00 - 163.50	67.00 - 67.50	3.331	.428	155.00	3.755	.176	75.61
1948	163.00 - 163.50	67.50 - 68.00	3.282	.447	178.83	3.763	.169	106.38
1949	163.00 - 163.50	68.00 - 68.50	3.282	.447	202.53	3.547	.153	102.89
1950	163.00 - 163.50	68.50 - 69.00	3.282	.447	227.85	3.443	.144	114.47
1951	163.00 - 163.50	69.00 - 69.50	3.245	.470	262.23	3.435	.157	141.99
1952	163.00 - 163.50	69.50 - 70.00	.000	.000	.00	3.372	.184	167.66
1953	163.00 - 163.50	70.00 - 70.50	.000	.000	.00	3.280	.183	196.12
1954	163.00 - 163.50	70.50 - 71.00	.000	.000	.00	2.822	.122	185.14
1955	163.50 - 164.00	54.00 - 54.50	3.103	.001	39.15	5.055	.248	39.80
1956	163.50 - 164.00	54.50 - 55.00	3.103	.001	65.13	5.071	.247	56.22
1957	163.50 - 164.00	55.00 - 55.50	3.103	.001	92.45	5.069	.247	99.34
1958	163.50 - 164.00	55.50 - 56.00	3.103	.001	114.78	5.060	.245	130.13
1959	163.50 - 164.00	56.00 - 56.50	2.979	.000	134.12	4.977	.218	148.22
1960	163.50 - 164.00	56.50 - 57.00	2.803	.000	147.19	4.800	.305	153.36

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1961	163.50 - 164.00	57.00 - 57.50	2.803	.000	178.44	4.627	.249	175.75
1962	163.50 - 164.00	57.50 - 58.00	2.502	.000	189.85	4.297	.260	183.63
1963	163.50 - 164.00	58.00 - 58.50	2.502	.000	221.67	4.110	.210	197.12
1964	163.50 - 164.00	58.50 - 59.00	.000	.000	.00	3.985	.249	216.30
1965	163.50 - 164.00	59.00 - 59.50	.000	.000	.00	3.767	.199	217.10
1966	163.50 - 164.00	59.50 - 60.00	.000	.000	.00	3.407	.179	208.16
1967	163.50 - 164.00	60.00 - 60.50	.000	.000	.00	3.013	.154	164.25
1968	163.50 - 164.00	60.50 - 61.00	.000	.000	.00	3.013	.154	145.48
1969	163.50 - 164.00	61.00 - 61.50	2.803	.000	218.01	2.954	.145	118.81
1970	163.50 - 164.00	61.50 - 62.00	2.803	.000	185.55	3.476	.310	160.12
1971	163.50 - 164.00	62.00 - 62.50	2.803	.000	153.95	3.567	.242	162.39
1972	163.50 - 164.00	62.50 - 63.00	2.979	.000	141.24	3.602	.231	158.19
1973	163.50 - 164.00	63.00 - 63.50	3.104	.000	122.75	3.602	.231	140.43
1974	163.50 - 164.00	63.50 - 64.00	3.104	.000	97.15	3.714	.205	124.33
1975	163.50 - 164.00	64.00 - 64.50	3.104	.000	85.50	3.759	.177	92.54
1976	163.50 - 164.00	64.50 - 65.00	3.104	.000	91.51	3.759	.177	39.63
1977	163.50 - 164.00	65.00 - 65.50	3.104	.000	101.47	3.783	.168	34.64
1978	163.50 - 164.00	65.50 - 66.00	3.104	.000	103.27	3.783	.168	75.35
1979	163.50 - 164.00	66.00 - 66.50	3.309	.434	117.52	3.759	.177	87.91
1980	163.50 - 164.00	66.50 - 67.00	3.309	.434	130.19	3.759	.177	70.89
1981	163.50 - 164.00	67.00 - 67.50	3.309	.434	152.79	3.751	.184	90.12
1982	163.50 - 164.00	67.50 - 68.00	3.282	.447	178.50	3.755	.176	111.60
1983	163.50 - 164.00	68.00 - 68.50	3.282	.447	204.19	3.534	.151	97.26
1984	163.50 - 164.00	68.50 - 69.00	3.282	.447	230.53	3.443	.144	113.07
1985	163.50 - 164.00	69.00 - 69.50	3.245	.470	267.11	3.394	.126	139.72
1986	163.50 - 164.00	69.50 - 70.00	.000	.000	.00	3.326	.150	164.96
1987	163.50 - 164.00	70.00 - 70.50	.000	.000	.00	3.199	.123	187.02
1988	163.50 - 164.00	70.50 - 71.00	.000	.000	.00	2.822	.122	187.10
1989	164.00 - 164.50	53.00 - 53.50	3.103	.001	34.28	5.068	.247	56.29
1990	164.00 - 164.50	53.50 - 54.00	3.103	.001	47.03	5.070	.248	42.17
1991	164.00 - 164.50	54.00 - 54.50	3.103	.001	18.33	5.070	.248	29.93
1992	164.00 - 164.50	54.50 - 55.00	3.103	.001	59.77	5.100	.256	64.56
1993	164.00 - 164.50	55.00 - 55.50	3.103	.001	96.53	5.098	.257	104.04
1994	164.00 - 164.50	55.50 - 56.00	3.103	.001	123.35	5.067	.243	130.73
1995	164.00 - 164.50	56.00 - 56.50	2.979	.000	143.53	4.977	.220	150.99

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
1996	164.00 - 164.50	56.50 - 57.00	2.803	.000	155.70	4.806	.308	158.94
1997	164.00 - 164.50	57.00 - 57.50	2.803	.000	185.48	4.623	.253	183.27
1998	164.00 - 164.50	57.50 - 58.00	2.502	.000	198.81	4.283	.274	191.94
1999	164.00 - 164.50	58.00 - 58.50	2.502	.000	229.38	3.984	.208	188.25
2000	164.00 - 164.50	58.50 - 59.00	.000	.000	.00	3.840	.215	204.06
2001	164.00 - 164.50	59.00 - 59.50	.000	.000	.00	3.739	.225	223.44
2002	164.00 - 164.50	59.50 - 60.00	.000	.000	.00	3.431	.204	220.27
2003	164.00 - 164.50	60.00 - 60.50	.000	.000	.00	3.013	.154	176.07
2004	164.00 - 164.50	60.50 - 61.00	.000	.000	.00	3.013	.154	159.33
2005	164.00 - 164.50	61.00 - 61.50	2.803	.000	218.01	2.954	.145	136.30
2006	164.00 - 164.50	61.50 - 62.00	2.803	.000	185.55	3.476	.310	180.48
2007	164.00 - 164.50	62.00 - 62.50	2.803	.000	153.95	3.567	.242	174.82
2008	164.00 - 164.50	62.50 - 63.00	2.979	.000	140.81	3.602	.231	164.40
2009	164.00 - 164.50	63.00 - 63.50	3.104	.000	122.23	3.602	.231	142.84
2010	164.00 - 164.50	63.50 - 64.00	3.104	.000	96.68	3.667	.248	119.96
2011	164.00 - 164.50	64.00 - 64.50	3.104	.000	84.87	3.705	.230	86.75
2012	164.00 - 164.50	64.50 - 65.00	3.104	.000	89.82	3.705	.230	50.73
2013	164.00 - 164.50	65.00 - 65.50	3.104	.000	96.46	3.733	.216	26.66
2014	164.00 - 164.50	65.50 - 66.00	3.104	.000	92.46	3.733	.216	68.76
2015	164.00 - 164.50	66.00 - 66.50	3.104	.000	88.58	3.759	.177	94.46
2016	164.00 - 164.50	66.50 - 67.00	3.104	.000	103.86	3.759	.177	91.53
2017	164.00 - 164.50	67.00 - 67.50	3.104	.000	133.70	3.751	.184	103.89
2018	164.00 - 164.50	67.50 - 68.00	3.245	.470	176.91	3.755	.176	114.31
2019	164.00 - 164.50	68.00 - 68.50	3.245	.470	206.71	3.534	.151	81.75
2020	164.00 - 164.50	68.50 - 69.00	3.245	.470	236.02	3.443	.144	107.58
2021	164.00 - 164.50	69.00 - 69.50	3.245	.470	272.00	3.394	.126	141.47
2022	164.00 - 164.50	69.50 - 70.00	.000	.000	.00	3.326	.150	168.11
2023	164.00 - 164.50	70.00 - 70.50	.000	.000	.00	3.199	.123	190.51
2024	164.00 - 164.50	70.50 - 71.00	.000	.000	.00	2.822	.122	189.38
2025	164.50 - 165.00	53.00 - 53.50	3.103	.001	13.08	5.093	.253	56.65
2026	164.50 - 165.00	53.50 - 54.00	3.103	.001	47.91	5.094	.253	34.42
2027	164.50 - 165.00	54.00 - 54.50	3.103	.001	39.17	5.094	.253	37.46
2028	164.50 - 165.00	54.50 - 55.00	3.103	.001	67.22	5.140	.272	71.36
2029	164.50 - 165.00	55.00 - 55.50	3.103	.001	102.58	5.137	.272	110.43
2030	164.50 - 165.00	55.50 - 56.00	3.103	.001	131.22	5.084	.248	124.20

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	C(H)	R(F)	A(N)	C(N)	R(N)
2031	164.50 - 165.00	56.00 - 56.50	2.979	.000	152.75	4.988	.224	152.05
2032	164.50 - 165.00	56.50 - 57.00	2.803	.000	164.93	4.799	.306	162.22
2033	164.50 - 165.00	57.00 - 57.50	2.803	.000	193.58	4.620	.250	188.63
2034	164.50 - 165.00	57.50 - 58.00	2.502	.000	209.23	4.276	.269	198.22
2035	164.50 - 165.00	58.00 - 58.50	2.803	.000	235.48	3.964	.221	195.26
2036	164.50 - 165.00	58.50 - 59.00	2.502	.000	249.88	3.806	.246	210.53
2037	164.50 - 165.00	59.00 - 59.50	2.502	.000	270.47	3.705	.258	232.94
2038	164.50 - 165.00	59.50 - 60.00	2.502	.000	293.67	3.358	.249	231.32
2039	164.50 - 165.00	60.00 - 60.50	.000	.000	.00	2.881	.147	185.80
2040	164.50 - 165.00	60.50 - 61.00	.000	.000	.00	2.881	.147	166.74
2041	164.50 - 165.00	61.00 - 61.50	2.803	.000	218.63	2.954	.145	153.37
2042	164.50 - 165.00	61.50 - 62.00	2.803	.000	186.09	3.476	.310	197.25
2043	164.50 - 165.00	62.00 - 62.50	2.803	.000	154.25	3.567	.242	185.19
2044	164.50 - 165.00	62.50 - 63.00	2.979	.000	140.03	3.602	.231	170.03
2045	164.50 - 165.00	63.00 - 63.50	3.104	.000	119.44	3.602	.231	145.32
2046	164.50 - 165.00	63.50 - 64.00	3.104	.000	89.42	3.667	.248	119.83
2047	164.50 - 165.00	64.00 - 64.50	3.104	.000	73.85	3.705	.230	84.60
2048	164.50 - 165.00	64.50 - 65.00	3.104	.000	82.78	3.705	.230	54.03
2049	164.50 - 165.00	65.00 - 65.50	3.104	.000	90.05	3.733	.216	27.09
2050	164.50 - 165.00	65.50 - 66.00	3.104	.000	80.63	3.733	.216	70.25
2051	164.50 - 165.00	66.00 - 66.50	3.104	.000	70.94	3.711	.220	97.03
2052	164.50 - 165.00	66.50 - 67.00	3.104	.000	89.55	3.711	.220	103.19
2053	164.50 - 165.00	67.00 - 67.50	3.104	.000	124.29	3.711	.220	112.98
2054	164.50 - 165.00	67.50 - 68.00	2.803	.000	129.90	3.755	.176	114.38
2055	164.50 - 165.00	68.00 - 68.50	2.803	.000	163.06	3.534	.151	54.73
2056	164.50 - 165.00	68.50 - 69.00	2.803	.000	196.59	3.443	.144	101.23
2057	164.50 - 165.00	69.00 - 69.50	3.188	.521	278.82	3.518	.185	158.52
2058	164.50 - 165.00	69.50 - 70.00	.000	.000	.00	3.458	.226	188.97
2059	164.50 - 165.00	70.00 - 70.50	.000	.000	.00	3.326	.150	209.22
2060	164.50 - 165.00	70.50 - 71.00	.000	.000	.00	2.822	.122	191.98
2061	165.00 - 165.50	53.00 - 53.50	3.103	.001	38.90	5.131	.267	67.72
2062	165.00 - 165.50	53.50 - 54.00	3.103	.001	57.51	5.132	.267	36.65
2063	165.00 - 165.50	54.00 - 54.50	3.103	.001	63.92	5.132	.267	52.67
2064	165.00 - 165.50	54.50 - 55.00	3.152	.049	86.13	5.146	.273	84.61
2065	165.00 - 165.50	55.00 - 55.50	3.152	.049	114.94	5.142	.272	114.72

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2066	165.00 - 165.50	55.50 - 56.00	3.152	.049	140.44	5.083	.244	90.25
2067	165.00 - 165.50	56.00 - 56.50	3.104	.000	168.46	4.983	.221	151.76
2068	165.00 - 165.50	56.50 - 57.00	2.979	.000	179.32	4.780	.299	163.19
2069	165.00 - 165.50	57.00 - 57.50	2.979	.000	199.06	4.600	.254	192.02
2070	165.00 - 165.50	57.50 - 58.00	2.803	.000	210.54	4.234	.284	201.80
2071	165.00 - 165.50	58.00 - 58.50	2.803	.000	230.43	3.958	.225	200.89
2072	165.00 - 165.50	58.50 - 59.00	2.502	.000	234.36	3.797	.256	216.04
2073	165.00 - 165.50	59.00 - 59.50	2.502	.000	256.20	3.692	.271	238.96
2074	165.00 - 165.50	59.50 - 60.00	2.502	.000	280.59	3.358	.249	237.86
2075	165.00 - 165.50	60.00 - 60.50	.000	.000	.00	2.881	.147	198.54
2076	165.00 - 165.50	60.50 - 61.00	.000	.000	.00	2.881	.147	181.34
2077	165.00 - 165.50	61.00 - 61.50	2.803	.000	219.88	2.881	.147	167.08
2078	165.00 - 165.50	61.50 - 62.00	2.803	.000	187.22	3.451	.334	211.49
2079	165.00 - 165.50	62.00 - 62.50	2.803	.000	154.98	3.551	.257	193.89
2080	165.00 - 165.50	62.50 - 63.00	2.979	.000	139.26	3.587	.245	174.36
2081	165.00 - 165.50	63.00 - 63.50	3.104	.000	115.59	3.587	.245	146.82
2082	165.00 - 165.50	63.50 - 64.00	3.104	.000	78.19	3.667	.248	120.64
2083	165.00 - 165.50	64.00 - 64.50	3.104	.000	55.15	3.705	.230	80.69
2084	165.00 - 165.50	64.50 - 65.00	3.104	.000	72.81	3.711	.220	42.24
2085	165.00 - 165.50	65.00 - 65.50	3.104	.000	83.26	3.738	.207	44.09
2086	165.00 - 165.50	65.50 - 66.00	3.104	.000	68.82	3.738	.207	77.10
2087	165.00 - 165.50	66.00 - 66.50	3.104	.000	51.34	3.711	.220	102.80
2088	165.00 - 165.50	66.50 - 67.00	3.104	.000	76.11	3.711	.220	114.40
2089	165.00 - 165.50	67.00 - 67.50	3.104	.000	116.45	3.711	.220	123.10
2090	165.00 - 165.50	67.50 - 68.00	2.803	.000	124.66	3.758	.239	116.39
2091	165.00 - 165.50	68.00 - 68.50	2.803	.000	158.86	3.579	.200	36.70
2092	165.00 - 165.50	68.50 - 69.00	2.803	.000	193.06	3.472	.257	102.17
2093	165.00 - 165.50	69.00 - 69.50	2.502	.000	209.10	3.518	.185	161.16
2094	165.00 - 165.50	69.50 - 70.00	.000	.000	.00	3.458	.226	192.36
2095	165.50 - 166.00	53.00 - 53.50	3.103	.001	64.47	5.141	.269	66.72
2096	165.50 - 166.00	53.50 - 54.00	3.152	.049	76.82	5.142	.270	34.34
2097	165.50 - 166.00	54.00 - 54.50	3.152	.049	87.16	5.141	.270	53.68
2098	165.50 - 166.00	54.50 - 55.00	3.152	.049	103.08	5.161	.278	87.24
2099	165.50 - 166.00	55.00 - 55.50	3.152	.049	125.77	5.154	.277	120.85
2100	165.50 - 166.00	55.50 - 56.00	3.152	.049	147.72	5.087	.245	128.13

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	C(N)	R(N)
2101	165.50 - 166.00	56.00 - 56.50	3.104	.000	173.10	4.982	.219	156.08
2102	165.50 - 166.00	56.50 - 57.00	2.979	.000	180.18	4.776	.295	164.82
2103	165.50 - 166.00	57.00 - 57.50	2.979	.000	196.78	4.588	.252	193.72
2104	165.50 - 166.00	57.50 - 58.00	2.803	.000	204.07	4.202	.286	202.59
2105	165.50 - 166.00	58.00 - 58.50	2.803	.000	223.42	3.895	.229	201.70
2106	165.50 - 166.00	58.50 - 59.00	2.502	.000	219.38	3.731	.262	218.02
2107	165.50 - 166.00	59.00 - 59.50	2.502	.000	242.57	3.600	.290	241.08
2108	165.50 - 166.00	59.50 - 60.00	2.502	.000	268.20	3.081	.318	227.55
2109	165.50 - 166.00	60.00 - 60.50	.000	.000	.00	2.296	.225	166.97
2110	165.50 - 166.00	60.50 - 61.00	.000	.000	.00	2.296	.225	148.08
2111	165.50 - 166.00	61.00 - 61.50	2.803	.000	221.79	2.881	.147	183.65
2112	165.50 - 166.00	61.50 - 62.00	2.803	.000	189.02	3.451	.334	224.14
2113	165.50 - 166.00	62.00 - 62.50	2.803	.000	156.34	3.551	.257	202.03
2114	165.50 - 166.00	62.50 - 63.00	2.979	.000	139.13	3.587	.245	179.77
2115	165.50 - 166.00	63.00 - 63.50	3.104	.000	112.51	3.587	.245	150.59
2116	165.50 - 166.00	63.50 - 64.00	3.104	.000	67.67	3.653	.262	121.73
2117	165.50 - 166.00	64.00 - 64.50	3.104	.000	32.86	3.705	.230	79.53
2118	165.50 - 166.00	64.50 - 65.00	3.104	.000	63.50	3.711	.220	26.23
2119	165.50 - 166.00	65.00 - 65.50	3.104	.000	76.89	3.738	.207	61.08
2120	165.50 - 166.00	65.50 - 66.00	3.104	.000	58.72	3.738	.207	86.22
2121	165.50 - 166.00	66.00 - 66.50	3.104	.000	30.94	3.758	.239	112.27
2122	165.50 - 166.00	66.50 - 67.00	3.104	.000	65.73	3.758	.239	126.89
2123	165.50 - 166.00	67.00 - 67.50	3.104	.000	110.94	3.758	.239	135.58
2124	165.50 - 166.00	67.50 - 68.00	2.803	.000	121.01	3.758	.239	123.23
2125	165.50 - 166.00	68.00 - 68.50	2.803	.000	155.88	3.579	.200	57.96
2126	165.50 - 166.00	68.50 - 69.00	2.803	.000	190.53	3.472	.257	107.73
2127	165.50 - 166.00	69.00 - 69.50	2.502	.000	207.71	3.421	.261	154.88
2128	165.50 - 166.00	69.50 - 70.00	.000	.000	.00	3.421	.261	192.62
2129	166.00 - 166.50	53.00 - 53.50	3.103	.001	86.86	5.167	.282	54.60
2130	166.00 - 166.50	53.50 - 54.00	3.152	.049	95.46	5.168	.282	54.93
2131	166.00 - 166.50	54.00 - 54.50	3.152	.049	105.15	5.166	.282	71.39
2132	166.00 - 166.50	54.50 - 55.00	3.152	.049	119.04	5.177	.287	101.11
2133	166.00 - 166.50	55.00 - 55.50	3.152	.049	136.98	5.170	.286	127.21
2134	166.00 - 166.50	55.50 - 56.00	3.152	.049	154.56	5.090	.248	138.31
2135	166.00 - 166.50	56.00 - 56.50	3.104	.000	175.49	4.974	.218	159.52

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2136	166.00 - 166.50	56.50 - 57.00	2.979	.000	177.57	4.765	.294	162.07
2137	166.00 - 166.50	57.00 - 57.50	2.979	.000	191.23	4.571	.255	191.76
2138	166.00 - 166.50	57.50 - 58.00	2.803	.000	194.57	4.153	.303	200.09
2139	166.00 - 166.50	58.00 - 58.50	2.803	.000	214.41	3.830	.215	197.21
2140	166.00 - 166.50	58.50 - 59.00	2.502	.000	205.05	3.709	.267	219.82
2141	166.00 - 166.50	59.00 - 59.50	2.502	.000	229.69	3.600	.290	245.78
2142	166.00 - 166.50	59.50 - 60.00	2.502	.000	256.61	3.081	.318	229.21
2143	166.00 - 166.50	60.00 - 60.50	.000	.000	.00	2.296	.225	180.03
2144	166.00 - 166.50	60.50 - 61.00	.000	.000	.00	2.296	.225	162.66
2145	166.00 - 166.50	61.00 - 61.50	2.803	.000	224.41	2.296	.225	151.29
2146	166.00 - 166.50	61.50 - 62.00	2.803	.000	191.58	3.332	.430	232.51
2147	166.00 - 166.50	62.00 - 62.50	2.803	.000	158.58	3.498	.290	210.35
2148	166.00 - 166.50	62.50 - 63.00	2.979	.000	140.21	3.542	.271	184.45
2149	166.00 - 166.50	63.00 - 63.50	3.104	.000	111.92	3.542	.271	152.36
2150	166.00 - 166.50	63.50 - 64.00	3.104	.000	63.33	3.653	.262	126.68
2151	166.00 - 166.50	64.00 - 64.50	3.104	.000	18.47	3.753	.248	90.15
2152	166.00 - 166.50	64.50 - 65.00	3.104	.000	59.32	3.758	.239	47.06
2153	166.00 - 166.50	65.00 - 65.50	3.104	.000	71.06	3.779	.235	76.54
2154	166.00 - 166.50	65.50 - 66.00	3.104	.000	51.69	3.779	.235	97.32
2155	166.00 - 166.50	66.00 - 66.50	3.104	.000	18.35	3.758	.239	116.24
2156	166.00 - 166.50	66.50 - 67.00	3.104	.000	61.32	3.758	.239	133.23
2157	166.00 - 166.50	67.00 - 67.50	3.104	.000	108.33	3.758	.239	142.99
2158	166.00 - 166.50	67.50 - 68.00	2.803	.000	119.05	3.758	.239	134.82
2159	166.00 - 166.50	68.00 - 68.50	2.803	.000	154.18	3.579	.200	90.77
2160	166.00 - 166.50	68.50 - 69.00	2.803	.000	189.02	3.472	.257	119.82
2161	166.00 - 166.50	69.00 - 69.50	2.502	.000	207.24	3.421	.261	160.56
2162	166.00 - 166.50	69.50 - 70.00	.000	.000	.00	3.421	.261	196.86
2163	166.50 - 167.00	53.00 - 53.50	3.041	.061	102.87	5.181	.286	44.79
2164	166.50 - 167.00	53.50 - 54.00	3.103	.001	111.17	5.181	.286	55.17
2165	166.50 - 167.00	54.00 - 54.50	3.103	.001	119.91	5.130	.334	63.12
2166	166.50 - 167.00	54.50 - 55.00	3.152	.049	133.79	5.178	.287	107.02
2167	166.50 - 167.00	55.00 - 55.50	3.152	.049	147.41	5.170	.266	126.90
2168	166.50 - 167.00	55.50 - 56.00	3.152	.049	159.86	5.088	.249	118.36
2169	166.50 - 167.00	56.00 - 56.50	3.104	.000	174.39	4.970	.219	159.65
2170	166.50 - 167.00	56.50 - 57.00	2.979	.000	170.44	4.759	.295	141.22

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2171	166.50 - 167.00	57.00 - 57.50	2.979	.000	181.73	4.549	.261	183.93
2172	166.50 - 167.00	57.50 - 58.00	2.803	.000	182.25	4.092	.331	194.01
2173	166.50 - 167.00	58.00 - 58.50	2.803	.000	203.63	3.718	.228	136.84
2174	166.50 - 167.00	58.50 - 59.00	2.502	.000	191.51	3.650	.254	216.45
2175	166.50 - 167.00	59.00 - 59.50	2.502	.000	217.69	3.508	.294	237.36
2176	166.50 - 167.00	59.50 - 60.00	2.502	.000	245.93	3.081	.318	230.84
2177	166.50 - 167.00	60.00 - 60.50	.000	.000	.00	2.296	.225	193.59
2178	166.50 - 167.00	60.50 - 61.00	.000	.000	.00	2.296	.225	177.56
2179	166.50 - 167.00	61.00 - 61.50	2.803	.000	227.77	2.296	.225	167.20
2180	166.50 - 167.00	61.50 - 62.00	2.803	.000	195.01	2.984	.309	199.92
2181	166.50 - 167.00	62.00 - 62.50	2.803	.000	161.91	3.258	.173	137.87
2182	166.50 - 167.00	62.50 - 63.00	2.979	.000	142.94	3.329	.176	165.61
2183	166.50 - 167.00	63.00 - 63.50	3.104	.000	114.76	3.329	.176	135.30
2184	166.50 - 167.00	63.50 - 64.00	3.104	.000	68.21	3.614	.286	130.52
2185	166.50 - 167.00	64.00 - 64.50	3.104	.000	32.89	3.699	.273	98.93
2186	166.50 - 167.00	64.50 - 65.00	3.104	.000	62.52	3.705	.263	71.21
2187	166.50 - 167.00	65.00 - 65.50	3.104	.000	65.35	3.730	.255	84.97
2188	166.50 - 167.00	65.50 - 66.00	3.104	.000	44.58	3.730	.255	94.79
2189	166.50 - 167.00	66.00 - 66.50	3.104	.000	30.16	3.753	.248	116.73
2190	166.50 - 167.00	66.50 - 67.00	3.104	.000	64.11	3.753	.248	137.62
2191	166.50 - 167.00	67.00 - 67.50	3.104	.000	108.79	3.753	.248	149.43
2192	166.50 - 167.00	67.50 - 68.00	2.803	.000	118.79	3.758	.239	147.31
2193	166.50 - 167.00	68.00 - 68.50	2.803	.000	153.76	3.579	.200	117.73
2194	166.50 - 167.00	68.50 - 69.00	2.803	.000	188.55	3.472	.257	134.18
2195	166.50 - 167.00	69.00 - 69.50	2.502	.000	207.71	3.421	.261	167.44
2196	166.50 - 167.00	69.50 - 70.00	.000	.000	.00	3.421	.261	201.54
2197	167.00 - 167.50	52.00 - 52.50	3.041	.061	138.59	5.183	.282	65.69
2198	167.00 - 167.50	52.50 - 53.00	3.041	.061	127.18	5.184	.283	38.17
2199	167.00 - 167.50	53.00 - 53.50	3.041	.061	122.55	5.184	.283	43.35
2200	167.00 - 167.50	53.50 - 54.00	3.103	.001	129.48	5.184	.283	50.09
2201	167.00 - 167.50	54.00 - 54.50	3.103	.001	136.27	5.128	.329	74.20
2202	167.00 - 167.50	54.50 - 55.00	3.103	.001	146.10	5.117	.327	105.34
2203	167.00 - 167.50	55.00 - 55.50	3.103	.001	156.24	5.109	.324	100.19
2204	167.00 - 167.50	55.50 - 56.00	3.103	.001	163.07	5.020	.276	136.31
2205	167.00 - 167.50	56.00 - 56.50	2.979	.000	157.42	4.897	.231	144.55

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2206	167.00 - 167.50	56.50 - 57.00	2.803	.000	140.43	4.733	.284	87.49
2207	167.00 - 167.50	57.00 - 57.50	2.803	.000	149.07	4.500	.253	174.93
2208	167.00 - 167.50	57.50 - 58.00	2.502	.000	133.20	3.945	.320	178.45
2209	167.00 - 167.50	58.00 - 58.50	2.803	.000	191.55	3.643	.267	180.92
2210	167.00 - 167.50	58.50 - 59.00	2.502	.000	178.96	3.600	.290	215.39
2211	167.00 - 167.50	59.00 - 59.50	2.502	.000	206.73	3.488	.312	240.27
2212	167.00 - 167.50	59.50 - 60.00	2.502	.000	236.29	3.081	.318	232.60
2213	167.00 - 167.50	60.00 - 60.50	.000	.000	.00	2.296	.225	207.55
2214	167.00 - 167.50	60.50 - 61.00	.000	.000	.00	2.296	.225	192.68
2215	167.00 - 167.50	61.00 - 61.50	2.803	.000	231.91	2.296	.225	183.18
2216	167.00 - 167.50	61.50 - 62.00	2.803	.000	199.35	2.984	.309	208.00
2217	167.00 - 167.50	62.00 - 62.50	2.803	.000	166.46	3.258	.173	193.79
2218	167.00 - 167.50	62.50 - 63.00	2.979	.000	147.44	3.329	.176	170.75
2219	167.00 - 167.50	63.00 - 63.50	3.104	.000	120.97	3.329	.176	141.09
2220	167.00 - 167.50	63.50 - 64.00	3.104	.000	80.17	3.460	.241	124.22
2221	167.00 - 167.50	64.00 - 64.50	3.104	.000	55.58	3.570	.271	102.83
2222	167.00 - 167.50	64.50 - 65.00	3.104	.000	70.37	3.579	.258	83.33
2223	167.00 - 167.50	65.00 - 65.50	3.104	.000	60.20	3.579	.258	81.27
2224	167.00 - 167.50	65.50 - 66.00	3.104	.000	30.39	3.579	.258	72.71
2225	167.00 - 167.50	66.00 - 66.50	3.104	.000	44.56	3.730	.255	111.25
2226	167.00 - 167.50	66.50 - 67.00	3.104	.000	71.66	3.730	.255	139.13
2227	167.00 - 167.50	67.00 - 67.50	3.104	.000	111.97	3.730	.255	153.53
2228	167.00 - 167.50	67.50 - 68.00	2.803	.000	120.14	3.753	.248	158.04
2229	167.00 - 167.50	68.00 - 68.50	2.803	.000	154.58	3.572	.212	137.07
2230	167.00 - 167.50	68.50 - 69.00	2.803	.000	189.11	3.460	.275	147.00
2231	167.00 - 167.50	69.00 - 69.50	2.502	.000	209.10	3.421	.261	174.73
2232	167.00 - 167.50	69.50 - 70.00	.000	.000	.00	3.421	.261	206.43
2233	167.50 - 168.00	52.00 - 52.50	3.041	.061	156.25	5.181	.280	66.00
2234	167.50 - 168.00	52.50 - 53.00	3.041	.061	146.11	5.182	.281	40.50
2235	167.50 - 168.00	53.00 - 53.50	3.041	.061	141.98	5.182	.281	32.77
2236	167.50 - 168.00	53.50 - 54.00	3.103	.001	147.03	5.181	.281	39.03
2237	167.50 - 168.00	54.00 - 54.50	3.103	.001	151.58	5.124	.327	31.49
2238	167.50 - 168.00	54.50 - 55.00	3.103	.001	157.71	5.112	.322	109.64
2239	167.50 - 168.00	55.00 - 55.50	3.103	.001	161.79	5.099	.318	125.29
2240	167.50 - 168.00	55.50 - 56.00	3.103	.001	160.20	5.007	.267	144.22

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2241	167.50 - 168.00	56.00 - 56.50	2.979	.000	143.71	4.874	.217	110.82
2242	167.50 - 168.00	56.50 - 57.00	2.803	.000	121.82	4.721	.278	139.89
2243	167.50 - 168.00	57.00 - 57.50	2.803	.000	130.46	4.472	.248	182.02
2244	167.50 - 168.00	57.50 - 58.00	2.502	.000	117.50	3.897	.339	176.81
2245	167.50 - 168.00	58.00 - 58.50	2.502	.000	140.56	3.440	.244	158.36
2246	167.50 - 168.00	58.50 - 59.00	2.502	.000	167.60	3.343	.272	197.79
2247	167.50 - 168.00	59.00 - 59.50	2.502	.000	196.98	3.187	.329	213.94
2248	167.50 - 168.00	59.50 - 60.00	2.502	.000	227.80	2.998	.367	232.50
2249	167.50 - 168.00	60.00 - 60.50	.000	.000	.00	.000	.000	.00
2250	167.50 - 168.00	60.50 - 61.00	.000	.000	.00	.000	.000	.00
2251	167.50 - 168.00	61.00 - 61.50	2.803	.000	236.83	2.296	.225	199.22
2252	167.50 - 168.00	61.50 - 62.00	2.803	.000	204.65	2.984	.309	215.96
2253	167.50 - 168.00	62.00 - 62.50	2.803	.000	172.27	3.258	.173	200.25
2254	167.50 - 168.00	62.50 - 63.00	2.979	.000	153.62	3.329	.176	176.75
2255	167.50 - 168.00	63.00 - 63.50	3.104	.000	129.77	3.329	.176	148.01
2256	167.50 - 168.00	63.50 - 64.00	3.104	.000	95.19	3.460	.241	133.92
2257	167.50 - 168.00	64.00 - 64.50	3.104	.000	76.42	3.570	.271	117.26
2258	167.50 - 168.00	64.50 - 65.00	3.104	.000	79.29	3.579	.258	99.24
2259	167.50 - 168.00	65.00 - 65.50	3.104	.000	58.56	3.579	.258	83.41
2260	167.50 - 168.00	65.50 - 66.00	3.104	.000	18.33	3.579	.258	48.60
2261	167.50 - 168.00	66.00 - 66.50	3.104	.000	52.16	3.579	.258	91.73
2262	167.50 - 168.00	66.50 - 67.00	3.104	.000	80.72	3.579	.258	125.81
2263	167.50 - 168.00	67.00 - 67.50	3.104	.000	117.24	3.579	.258	141.55
2264	167.50 - 168.00	67.50 - 68.00	2.803	.000	122.96	3.730	.255	164.43
2265	167.50 - 168.00	68.00 - 68.50	2.803	.000	156.61	3.535	.210	147.11
2266	167.50 - 168.00	68.50 - 69.00	2.803	.000	190.66	3.409	.281	153.02
2267	167.50 - 168.00	69.00 - 69.50	2.502	.000	211.39	3.409	.281	181.59
2268	167.50 - 168.00	69.50 - 70.00	.000	.000	.00	3.409	.281	211.86
2269	168.00 - 168.50	52.00 - 52.50	3.041	.061	174.19	5.173	.275	50.93
2270	168.00 - 168.50	52.50 - 53.00	3.041	.061	165.05	5.174	.276	31.51
2271	168.00 - 168.50	53.00 - 53.50	3.041	.061	161.31	5.174	.275	43.96
2272	168.00 - 168.50	53.50 - 54.00	3.103	.001	163.60	5.173	.276	57.05
2273	168.00 - 168.50	54.00 - 54.50	3.103	.001	165.59	5.114	.321	97.44
2274	168.00 - 168.50	54.50 - 55.00	3.103	.001	167.38	5.127	.329	115.38
2275	168.00 - 168.50	55.00 - 55.50	3.103	.001	164.52	5.107	.322	128.51

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
2276	168.00 - 168.50	55.50 - 56.00	3.103	.001	153.31	5.005	.266	150.06
2277	168.00 - 168.50	56.00 - 56.50	2.979	.000	125.63	4.863	.213	153.44
2278	168.00 - 168.50	56.50 - 57.00	2.803	.000	100.48	4.701	.273	168.37
2279	168.00 - 168.50	57.00 - 57.50	2.803	.000	110.37	4.420	.250	189.94
2280	168.00 - 168.50	57.50 - 58.00	2.502	.000	102.89	3.766	.318	164.17
2281	168.00 - 168.50	58.00 - 58.50	2.502	.000	128.60	3.348	.224	151.16
2282	168.00 - 168.50	58.50 - 59.00	2.502	.000	157.70	3.215	.271	177.18
2283	168.00 - 168.50	59.00 - 59.50	2.502	.000	188.63	2.939	.298	185.50
2284	168.00 - 168.50	59.50 - 60.00	2.502	.000	220.62	2.822	.367	212.73
2285	168.00 - 168.50	60.00 - 60.50	.000	.000	.00	.000	.000	.00
2286	168.00 - 168.50	60.50 - 61.00	.000	.000	.00	.000	.000	.00
2287	168.00 - 168.50	61.00 - 61.50	2.502	.000	215.74	.000	.000	.00
2288	168.00 - 168.50	61.50 - 62.00	2.502	.000	182.89	2.896	.375	230.11
2289	168.00 - 168.50	62.00 - 62.50	2.502	.000	150.79	3.227	.188	210.48
2290	168.00 - 168.50	62.50 - 63.00	2.803	.000	145.83	3.302	.192	183.46
2291	168.00 - 168.50	63.00 - 63.50	2.979	.000	129.53	3.302	.192	154.12
2292	168.00 - 168.50	63.50 - 64.00	3.104	.000	110.63	3.460	.241	144.42
2293	168.00 - 168.50	64.00 - 64.50	3.104	.000	94.10	3.570	.271	130.91
2294	168.00 - 168.50	64.50 - 65.00	3.104	.000	88.31	3.579	.258	112.13
2295	168.00 - 168.50	65.00 - 65.50	3.104	.000	63.32	3.579	.258	85.09
2296	168.00 - 168.50	65.50 - 66.00	3.104	.000	31.27	3.579	.258	29.22
2297	168.00 - 168.50	66.00 - 66.50	3.104	.000	59.97	3.579	.258	89.26
2298	168.00 - 168.50	66.50 - 67.00	3.104	.000	90.16	3.579	.258	127.27
2299	168.00 - 168.50	67.00 - 67.50	3.104	.000	124.08	3.579	.258	142.91
2300	168.00 - 168.50	67.50 - 68.00	2.803	.000	127.08	3.579	.258	151.60
2301	168.00 - 168.50	68.00 - 68.50	2.803	.000	159.76	3.471	.225	150.22
2302	168.00 - 168.50	68.50 - 69.00	2.803	.000	193.18	3.310	.320	152.35
2303	168.00 - 168.50	69.00 - 69.50	2.502	.000	214.57	3.346	.291	180.52
2304	168.00 - 168.50	69.50 - 70.00	.000	.000	.00	3.346	.291	209.35
2305	168.50 - 169.00	52.00 - 52.50	2.803	.000	198.99	5.184	.281	41.95
2306	168.50 - 169.00	52.50 - 53.00	2.803	.000	185.62	5.185	.281	37.43
2307	168.50 - 169.00	53.00 - 53.50	2.803	.000	178.01	5.185	.281	49.69
2308	168.50 - 169.00	53.50 - 54.00	2.979	.000	186.63	5.180	.279	74.41
2309	168.50 - 169.00	54.00 - 54.50	2.979	.000	180.90	5.120	.323	95.22
2310	168.50 - 169.00	54.50 - 55.00	3.103	.001	175.16	5.128	.328	119.53

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2311	168.50 - 169.00	55.00 - 55.50	3.103	.001	164.81	5.094	.313	100.00
2312	168.50 - 169.00	55.50 - 56.00	3.103	.001	143.32	4.983	.253	153.49
2313	168.50 - 169.00	56.00 - 56.50	2.979	.000	104.60	4.835	.204	169.95
2314	168.50 - 169.00	56.50 - 57.00	2.803	.000	77.22	4.650	.263	172.03
2315	168.50 - 169.00	57.00 - 57.50	2.803	.000	89.81	4.316	.240	182.93
2316	168.50 - 169.00	57.50 - 58.00	2.502	.000	89.90	3.646	.244	150.84
2317	168.50 - 169.00	58.00 - 58.50	2.502	.000	118.46	3.348	.224	153.03
2318	168.50 - 169.00	58.50 - 59.00	2.502	.000	149.55	3.215	.271	179.21
2319	168.50 - 169.00	59.00 - 59.50	2.502	.000	181.87	2.939	.298	185.91
2320	168.50 - 169.00	59.50 - 60.00	2.502	.000	214.87	2.822	.367	212.73
2321	168.50 - 169.00	60.00 - 60.50	.000	.000	.00	.000	.000	.00
2322	168.50 - 169.00	60.50 - 61.00	.000	.000	.00	.000	.000	.00
2323	168.50 - 169.00	61.00 - 61.50	2.502	.000	220.38	.000	.000	.00
2324	168.50 - 169.00	61.50 - 62.00	2.502	.000	188.34	2.896	.375	236.16
2325	168.50 - 169.00	62.00 - 62.50	2.502	.000	157.35	3.227	.188	217.41
2326	168.50 - 169.00	62.50 - 63.00	2.803	.000	153.56	3.302	.192	190.61
2327	168.50 - 169.00	63.00 - 63.50	2.979	.000	140.14	3.302	.192	162.56
2328	168.50 - 169.00	63.50 - 64.00	2.979	.000	114.28	3.436	.260	153.01
2329	168.50 - 169.00	64.00 - 64.50	2.979	.000	98.64	3.550	.286	141.54
2330	168.50 - 169.00	64.50 - 65.00	2.979	.000	87.84	3.560	.272	121.69
2331	168.50 - 169.00	65.00 - 65.50	2.979	.000	65.45	3.579	.258	92.80
2332	168.50 - 169.00	65.50 - 66.00	2.979	.000	45.98	3.579	.258	49.40
2333	168.50 - 169.00	66.00 - 66.50	3.104	.000	71.54	3.579	.258	94.96
2334	168.50 - 169.00	66.50 - 67.00	3.104	.000	100.27	3.579	.258	129.04
2335	168.50 - 169.00	67.00 - 67.50	3.104	.000	132.16	3.579	.258	142.09
2336	168.50 - 169.00	67.50 - 68.00	2.803	.000	132.35	3.579	.258	150.99
2337	168.50 - 169.00	68.00 - 68.50	2.803	.000	163.95	3.471	.225	152.54
2338	168.50 - 169.00	68.50 - 69.00	2.803	.000	196.62	3.310	.320	155.90
2339	168.50 - 169.00	69.00 - 69.50	2.502	.000	218.58	3.222	.342	173.20
2340	168.50 - 169.00	69.50 - 70.00	.000	.000	.00	3.222	.342	202.56
2341	169.00 - 169.50	51.00 - 51.50	2.502	.000	231.64	5.187	.278	68.07
2342	169.00 - 169.50	51.50 - 52.00	2.502	.000	212.90	5.188	.279	60.35
2343	169.00 - 169.50	52.00 - 52.50	2.502	.000	198.43	5.188	.279	28.88
2344	169.00 - 169.50	52.50 - 53.00	2.502	.000	189.22	5.189	.279	37.12
2345	169.00 - 169.50	53.00 - 53.50	2.502	.000	186.05	5.189	.279	57.10

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
2346	169.00 - 169.50	53.50 - 54.00	2.803	.000	199.01	5.184	.277	70.91
2347	169.50 - 170.00	51.00 - 51.50	.000	.000	.00	5.188	.281	61.38
2348	169.50 - 170.00	51.50 - 52.00	.000	.000	.00	5.188	.281	57.17
2349	169.50 - 170.00	52.00 - 52.50	.000	.000	.00	5.189	.281	26.84
2350	169.50 - 170.00	52.50 - 53.00	.000	.000	.00	5.190	.282	36.77
2351	169.50 - 170.00	53.00 - 53.50	.000	.000	.00	5.190	.282	41.99
2352	169.50 - 170.00	53.50 - 54.00	2.502	.000	208.10	5.185	.279	30.24
2353	170.00 - 170.50	51.00 - 51.50	.000	.000	.00	5.198	.285	59.36
2354	170.00 - 170.50	51.50 - 52.00	.000	.000	.00	5.199	.285	53.22
2355	170.00 - 170.50	52.00 - 52.50	.000	.000	.00	5.199	.286	36.32
2356	170.00 - 170.50	52.50 - 53.00	.000	.000	.00	5.200	.286	45.20
2357	170.00 - 170.50	53.00 - 53.50	.000	.000	.00	5.199	.285	47.26
2358	170.00 - 170.50	53.50 - 54.00	2.502	.000	207.24	5.194	.283	73.59
2359	170.50 - 171.00	51.00 - 51.50	.000	.000	.00	5.212	.293	43.04
2360	170.50 - 171.00	51.50 - 52.00	.000	.000	.00	5.213	.293	47.88
2361	170.50 - 171.00	52.00 - 52.50	.000	.000	.00	5.213	.293	36.77
2362	170.50 - 171.00	52.50 - 53.00	.000	.000	.00	5.213	.293	42.45
2363	170.50 - 171.00	53.00 - 53.50	.000	.000	.00	5.213	.293	54.23
2364	170.50 - 171.00	53.50 - 54.00	2.502	.000	208.10	5.208	.291	79.18
2365	171.00 - 171.50	51.00 - 51.50	3.062	.671	194.61	5.216	.293	43.87
2366	171.00 - 171.50	51.50 - 52.00	3.062	.671	197.64	5.216	.293	36.86
2367	171.00 - 171.50	52.00 - 52.50	3.062	.671	206.48	5.217	.293	33.44
2368	171.00 - 171.50	52.50 - 53.00	3.062	.671	220.42	5.217	.293	46.67
2369	171.50 - 172.00	51.00 - 51.50	3.062	.671	173.04	5.226	.302	45.22
2370	171.50 - 172.00	51.50 - 52.00	3.062	.671	176.45	5.226	.302	59.96
2371	171.50 - 172.00	52.00 - 52.50	3.062	.671	186.29	5.227	.302	49.55
2372	171.50 - 172.00	52.50 - 53.00	3.062	.671	201.63	5.227	.302	62.40
2373	172.00 - 172.50	51.00 - 51.50	3.062	.671	151.49	5.254	.296	71.29
2374	172.00 - 172.50	51.50 - 52.00	3.062	.671	155.37	5.254	.296	69.76
2375	172.00 - 172.50	52.00 - 52.50	3.062	.671	166.46	5.254	.296	59.17
2376	172.00 - 172.50	52.50 - 53.00	3.062	.671	183.47	5.254	.296	68.99
2377	172.50 - 173.00	51.00 - 51.50	3.062	.671	129.95	5.347	.242	78.22
2378	172.50 - 173.00	51.50 - 52.00	3.062	.671	134.45	5.347	.242	58.02
2379	172.50 - 173.00	52.00 - 52.50	3.062	.671	147.13	5.348	.242	64.14
2380	172.50 - 173.00	52.50 - 53.00	3.062	.671	166.13	5.347	.242	69.84

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	B(H)	R(H)	A(N)	B(N)	R(N)
2381	173.00 - 173.50	51.00 - 51.50	3.062	.671	108.43	5.346	.242	66.74
2382	173.00 - 173.50	51.50 - 52.00	3.062	.671	113.79	5.346	.242	41.80
2383	173.00 - 173.50	52.00 - 52.50	3.062	.671	128.53	5.346	.242	47.39
2384	173.00 - 173.50	52.50 - 53.00	3.062	.671	149.90	5.346	.242	58.72
2385	173.50 - 174.00	51.00 - 51.50	3.062	.671	86.95	5.370	.254	73.30
2386	173.50 - 174.00	51.50 - 52.00	3.062	.671	93.55	5.370	.254	37.83
2387	173.50 - 174.00	52.00 - 52.50	3.062	.671	111.00	5.370	.254	55.01
2388	173.50 - 174.00	52.50 - 53.00	3.062	.671	135.18	5.370	.254	69.96
2389	174.00 - 174.50	51.00 - 51.50	3.062	.671	65.55	5.373	.256	65.92
2390	174.00 - 174.50	51.50 - 52.00	3.062	.671	74.07	5.373	.256	40.02
2391	174.00 - 174.50	52.00 - 52.50	3.062	.671	95.17	5.373	.256	61.06
2392	174.00 - 174.50	52.50 - 53.00	3.062	.671	122.51	5.372	.256	74.24
2393	174.50 - 175.00	51.00 - 51.50	3.062	.671	44.33	5.429	.224	60.49
2394	174.50 - 175.00	51.50 - 52.00	3.062	.671	56.17	5.429	.224	45.55
2395	174.50 - 175.00	52.00 - 52.50	3.062	.671	82.01	5.429	.224	55.22
2396	174.50 - 175.00	52.50 - 53.00	3.062	.671	112.59	5.428	.224	62.96
2397	175.00 - 175.50	51.00 - 51.50	3.062	.671	23.80	5.480	.216	50.81
2398	175.00 - 175.50	51.50 - 52.00	3.062	.671	41.91	5.480	.216	38.39
2399	175.00 - 175.50	52.00 - 52.50	3.062	.671	72.99	5.480	.216	58.28
2400	175.00 - 175.50	52.50 - 53.00	3.062	.671	106.20	5.479	.216	66.65
2401	175.50 - 176.00	51.00 - 51.50	3.062	.671	10.00	5.476	.209	59.58
2402	175.50 - 176.00	51.50 - 52.00	3.062	.671	35.92	5.476	.209	45.20
2403	175.50 - 176.00	52.00 - 52.50	3.062	.671	69.72	5.476	.209	64.40
2404	175.50 - 176.00	52.50 - 53.00	3.062	.671	103.98	5.476	.209	79.53
2405	176.00 - 176.50	51.00 - 51.50	3.062	.671	23.80	5.425	.238	42.00
2406	176.00 - 176.50	51.50 - 52.00	3.062	.671	41.91	5.425	.238	38.03
2407	176.00 - 176.50	52.00 - 52.50	3.062	.671	72.99	5.425	.238	52.03
2408	176.00 - 176.50	52.50 - 53.00	3.062	.671	106.20	5.425	.238	70.68
2409	176.50 - 177.00	51.00 - 51.50	3.062	.671	44.33	5.452	.247	36.61
2410	176.50 - 177.00	51.50 - 52.00	3.062	.671	56.17	5.452	.247	41.98
2411	176.50 - 177.00	52.00 - 52.50	3.062	.671	82.01	5.452	.247	71.26
2412	176.50 - 177.00	52.50 - 53.00	3.062	.671	112.59	5.451	.247	45.86
2413	177.00 - 177.50	51.00 - 51.50	3.062	.671	65.55	5.488	.256	36.29
2414	177.00 - 177.50	51.50 - 52.00	3.062	.671	74.07	5.488	.256	41.04
2415	177.00 - 177.50	52.00 - 52.50	3.062	.671	95.17	5.488	.256	70.19

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	Q(H)	R(H)	A(N)	Q(N)	R(N)
2416	177.00 - 177.50	52.50 - 53.00	3.062	.671	122.51	5.488	.256	99.54
2417	177.50 - 178.00	51.00 - 51.50	3.062	.671	86.95	5.513	.265	40.06
2418	177.50 - 178.00	51.50 - 52.00	3.062	.671	93.55	5.513	.265	51.85
2419	177.50 - 178.00	52.00 - 52.50	3.062	.671	111.00	5.513	.265	78.79
2420	177.50 - 178.00	52.50 - 53.00	3.062	.671	135.18	5.513	.265	85.89
2421	178.00 - 178.50	51.00 - 51.50	3.062	.671	108.43	5.518	.265	34.79
2422	178.00 - 178.50	51.50 - 52.00	3.062	.671	113.79	5.518	.265	44.74
2423	178.00 - 178.50	52.00 - 52.50	3.062	.671	128.53	5.518	.265	67.39
2424	178.00 - 178.50	52.50 - 53.00	3.062	.671	149.90	5.518	.265	97.94
2425	178.50 - 179.00	51.00 - 51.50	3.062	.671	129.95	5.532	.271	34.34
2426	178.50 - 179.00	51.50 - 52.00	3.062	.671	134.45	5.532	.271	44.75
2427	178.50 - 179.00	52.00 - 52.50	3.062	.671	147.13	5.532	.272	67.30
2428	178.50 - 179.00	52.50 - 53.00	3.062	.671	166.13	5.532	.271	100.58
2429	179.00 - 179.50	51.00 - 51.50	3.062	.671	151.49	5.552	.280	24.79
2430	179.00 - 179.50	51.50 - 52.00	3.062	.671	155.37	5.552	.280	48.83
2431	179.00 - 179.50	52.00 - 52.50	3.062	.671	166.46	5.552	.280	76.36
2432	179.00 - 179.50	52.50 - 53.00	3.062	.671	183.47	5.552	.280	105.67
2433	179.50 - 180.00	51.00 - 51.50	3.062	.671	173.04	5.569	.289	30.91
2434	179.50 - 180.00	51.50 - 52.00	3.062	.671	176.45	5.569	.289	45.88
2435	179.50 - 180.00	52.00 - 52.50	3.062	.671	186.29	5.569	.289	61.57
2436	179.50 - 180.00	52.50 - 53.00	3.062	.671	201.63	5.569	.289	102.10
2437	180.00 - 180.50	51.00 - 51.50	3.062	.671	194.61	5.573	.295	41.49
2438	180.00 - 180.50	51.50 - 52.00	3.062	.671	197.64	5.573	.295	46.17
2439	180.00 - 180.50	52.00 - 52.50	3.062	.671	206.48	5.573	.295	70.04
2440	180.00 - 180.50	52.50 - 53.00	3.062	.671	220.42	5.573	.295	106.00
2441	180.50 - 181.00	51.00 - 51.50	.000	.000	.00	5.606	.307	29.00
2442	180.50 - 181.00	51.50 - 52.00	.000	.000	.00	5.606	.307	54.12
2443	180.50 - 181.00	52.00 - 52.50	.000	.000	.00	5.605	.307	82.12
2444	180.50 - 181.00	52.50 - 53.00	.000	.000	.00	5.605	.307	106.00
2445	181.00 - 181.50	51.00 - 51.50	.000	.000	.00	5.622	.314	31.06
2446	181.00 - 181.50	51.50 - 52.00	.000	.000	.00	5.622	.314	49.48
2447	181.00 - 181.50	52.00 - 52.50	.000	.000	.00	5.622	.314	77.81
2448	181.00 - 181.50	52.50 - 53.00	.000	.000	.00	5.622	.314	101.91
2449	181.50 - 182.00	51.00 - 51.50	2.802	.300	231.64	5.632	.320	34.53
2450	181.50 - 182.00	51.50 - 52.00	2.802	.300	212.90	5.632	.320	51.23

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2451	181.50 - 182.00	52.00 - 52.50	2.802	.300	198.43	5.632	.320	64.24
2452	181.50 - 182.00	52.50 - 53.00	2.802	.300	189.22	5.632	.320	106.34
2453	182.00 - 182.50	51.00 - 51.50	2.802	.300	215.44	5.650	.331	39.11
2454	182.00 - 182.50	51.50 - 52.00	2.802	.300	195.15	5.650	.331	49.41
2455	182.00 - 182.50	52.00 - 52.50	2.802	.300	179.25	5.650	.331	75.48
2456	182.00 - 182.50	52.50 - 53.00	2.802	.300	169.00	5.650	.331	106.12
2457	182.50 - 183.00	51.00 - 51.50	3.103	.300	213.98	5.659	.336	39.67
2458	182.50 - 183.00	51.50 - 52.00	3.103	.300	192.95	5.659	.336	52.72
2459	182.50 - 183.00	52.00 - 52.50	3.103	.300	176.20	5.659	.336	71.54
2460	182.50 - 183.00	52.50 - 53.00	3.103	.300	165.19	5.659	.336	102.63
2461	183.00 - 183.50	51.00 - 51.50	3.103	.300	198.78	5.661	.336	40.21
2462	183.00 - 183.50	51.50 - 52.00	3.103	.300	175.90	5.661	.336	37.56
2463	183.00 - 183.50	52.00 - 52.50	3.103	.300	157.24	5.661	.336	66.31
2464	183.00 - 183.50	52.50 - 53.00	3.103	.300	144.67	5.661	.336	93.45
2465	183.50 - 184.00	51.00 - 51.50	3.103	.300	184.70	5.670	.337	41.43
2466	183.50 - 184.00	51.50 - 52.00	3.103	.300	159.80	5.670	.337	33.30
2467	183.50 - 184.00	52.00 - 52.50	3.103	.300	138.87	5.670	.337	61.02
2468	183.50 - 184.00	52.50 - 53.00	3.103	.300	124.24	5.670	.337	91.19
2469	184.00 - 184.50	51.00 - 51.50	3.103	.300	172.00	5.648	.337	43.31
2470	184.00 - 184.50	51.50 - 52.00	3.103	.300	144.95	5.648	.337	33.69
2471	184.00 - 184.50	52.00 - 52.50	3.103	.300	121.39	5.648	.337	47.77
2472	184.00 - 184.50	52.50 - 53.00	3.103	.300	104.02	5.648	.337	77.89
2473	184.50 - 185.00	51.00 - 51.50	3.103	.300	160.99	5.623	.340	45.19
2474	184.50 - 185.00	51.50 - 52.00	3.103	.300	131.81	5.623	.340	33.76
2475	184.50 - 185.00	52.00 - 52.50	3.103	.300	105.31	5.623	.340	41.40
2476	184.50 - 185.00	52.50 - 53.00	3.103	.300	84.27	5.623	.340	70.15
2477	185.00 - 185.50	51.00 - 51.50	3.103	.300	152.01	5.615	.343	42.94
2478	185.00 - 185.50	51.50 - 52.00	3.103	.300	120.88	5.615	.343	29.88
2479	185.00 - 185.50	52.00 - 52.50	3.103	.300	91.46	5.615	.343	36.30
2480	185.00 - 185.50	52.50 - 53.00	3.103	.300	65.70	5.615	.343	70.70
2481	185.50 - 186.00	51.00 - 51.50	3.103	.300	145.36	5.668	.311	41.01
2482	185.50 - 186.00	51.50 - 52.00	3.103	.300	112.71	5.669	.311	33.21
2483	185.50 - 186.00	52.00 - 52.50	3.103	.300	80.94	5.669	.311	39.04
2484	185.50 - 186.00	52.50 - 53.00	3.103	.300	50.32	5.669	.311	71.95
2485	186.00 - 186.50	51.00 - 51.50	3.103	.300	141.27	5.639	.321	40.12

SEISMIC MAP OF ALASKA

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
2486	186.00 - 186.50	51.50 - 52.00	3.103	.300	107.69	5.639	.322	36.32
2487	186.00 - 186.50	52.00 - 52.50	3.103	.300	74.69	5.639	.322	39.02
2488	186.00 - 186.50	52.50 - 53.00	3.103	.300	42.26	5.639	.322	60.36
2489	186.50 - 187.00	51.00 - 51.50	3.103	.300	139.89	5.600	.334	47.32
2490	186.50 - 187.00	51.50 - 52.00	3.103	.300	106.01	5.601	.334	38.10
2491	186.50 - 187.00	52.00 - 52.50	3.103	.300	72.71	5.601	.334	28.73
2492	186.50 - 187.00	52.50 - 53.00	3.103	.300	41.43	5.601	.334	43.50
2493	187.00 - 187.50	51.00 - 51.50	3.103	.300	141.27	5.575	.329	54.90
2494	187.00 - 187.50	51.50 - 52.00	3.103	.300	107.69	5.575	.329	42.83
2495	187.00 - 187.50	52.00 - 52.50	3.103	.300	74.69	5.575	.329	33.79
2496	187.00 - 187.50	52.50 - 53.00	3.103	.300	42.26	5.575	.329	46.49
2497	187.50 - 188.00	51.00 - 51.50	3.103	.300	145.36	5.554	.328	62.44
2498	187.50 - 188.00	51.50 - 52.00	3.103	.300	112.71	5.555	.328	49.83
2499	187.50 - 188.00	52.00 - 52.50	3.103	.300	80.94	5.555	.328	37.73
2500	187.50 - 188.00	52.50 - 53.00	3.103	.300	50.32	5.555	.328	39.28
2501	188.00 - 188.50	51.00 - 51.50	3.103	.300	152.01	5.527	.325	70.02
2502	188.00 - 188.50	51.50 - 52.00	3.103	.300	120.88	5.527	.325	55.34
2503	188.00 - 188.50	52.00 - 52.50	3.103	.300	91.46	5.527	.325	42.14
2504	188.00 - 188.50	52.50 - 53.00	3.103	.300	65.70	5.527	.325	35.45
2505	188.50 - 189.00	51.00 - 51.50	3.103	.300	160.99	5.491	.320	36.89
2506	188.50 - 189.00	51.50 - 52.00	3.103	.300	131.81	5.492	.320	65.33
2507	188.50 - 189.00	52.00 - 52.50	3.103	.300	105.31	5.494	.320	45.63
2508	188.50 - 189.00	52.50 - 53.00	3.103	.300	84.27	5.494	.320	45.06
2509	189.00 - 189.50	51.00 - 51.50	3.103	.300	172.00	5.452	.311	105.46
2510	189.00 - 189.50	51.50 - 52.00	3.103	.300	144.95	5.466	.300	78.35
2511	189.00 - 189.50	52.00 - 52.50	3.103	.300	121.39	5.469	.301	61.51
2512	189.00 - 189.50	52.50 - 53.00	3.103	.300	104.02	5.469	.300	60.00
2513	189.50 - 190.00	51.00 - 51.50	3.103	.300	184.70	5.414	.305	106.84
2514	189.50 - 190.00	51.50 - 52.00	3.103	.300	159.80	5.430	.297	96.91
2515	189.50 - 190.00	52.00 - 52.50	3.103	.300	138.87	5.440	.300	77.81
2516	189.50 - 190.00	52.50 - 53.00	3.103	.300	124.24	5.442	.299	78.46

SEISMICITY FOR HAWAII

SEISMIC MAP OF HAWAII

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
1	154.00 - 154.50	18.00 - 18.50	4.169	.356	126.00	3.845	.204	37.11
2	154.00 - 154.50	18.50 - 19.00	4.182	.345	105.81	3.859	.200	73.89
3	154.00 - 154.50	19.00 - 19.50	4.253	.307	100.57	3.862	.197	71.79
4	154.00 - 154.50	19.50 - 20.00	4.253	.307	100.77	3.862	.197	76.55
5	154.00 - 154.50	20.00 - 20.50	4.253	.307	110.17	3.862	.197	90.54
6	154.00 - 154.50	20.50 - 21.00	4.253	.307	124.06	3.847	.188	108.50
7	154.50 - 155.00	18.00 - 18.50	4.171	.354	103.05	3.921	.197	77.83
8	154.50 - 155.00	18.50 - 19.00	4.185	.343	76.56	3.934	.191	59.08
9	154.50 - 155.00	19.00 - 19.50	4.256	.304	63.72	3.950	.193	44.57
10	154.50 - 155.00	19.50 - 20.00	4.256	.304	66.02	3.956	.190	53.00
11	154.50 - 155.00	20.00 - 20.50	4.256	.304	79.82	3.956	.190	73.26
12	154.50 - 155.00	20.50 - 21.00	4.256	.304	91.65	3.943	.184	91.04
13	155.00 - 155.50	18.00 - 18.50	4.174	.352	87.62	3.921	.197	75.04
14	155.00 - 155.50	18.50 - 19.00	4.187	.341	54.84	3.934	.191	44.12
15	155.00 - 155.50	19.00 - 19.50	4.260	.300	25.09	3.950	.193	14.48
16	155.00 - 155.50	19.50 - 20.00	4.260	.300	28.89	3.956	.190	23.71
17	155.00 - 155.50	20.00 - 20.50	4.260	.300	48.00	3.956	.190	57.11
18	155.00 - 155.50	20.50 - 21.00	4.260	.300	44.06	3.943	.184	47.06
19	155.50 - 156.00	18.00 - 18.50	4.174	.352	82.66	3.921	.197	74.70
20	155.50 - 156.00	18.50 - 19.00	4.187	.341	47.00	3.934	.191	37.35
21	155.50 - 156.00	19.00 - 19.50	4.260	.300	15.77	3.950	.193	18.68
22	155.50 - 156.00	19.50 - 20.00	4.260	.300	25.82	3.956	.190	24.73
23	155.50 - 156.00	20.00 - 20.50	4.260	.300	55.42	3.956	.190	46.15
24	155.50 - 156.00	20.50 - 21.00	4.260	.300	52.01	3.943	.184	46.41
25	156.00 - 156.50	18.00 - 18.50	4.174	.352	69.94	3.921	.197	84.90
26	156.00 - 156.50	18.50 - 19.00	4.187	.341	60.00	3.934	.191	59.50
27	156.00 - 156.50	19.00 - 19.50	4.260	.300	42.43	3.950	.193	45.52
28	156.00 - 156.50	19.50 - 20.00	4.260	.300	19.30	3.956	.190	38.40
29	156.00 - 156.50	20.00 - 20.50	4.260	.300	55.21	3.956	.190	67.38
30	156.00 - 156.50	20.50 - 21.00	4.260	.300	71.77	3.943	.184	79.78
31	156.00 - 156.50	21.00 - 21.50	4.260	.300	31.53	3.937	.187	56.35
32	156.00 - 156.50	21.50 - 22.00	3.969	.153	73.80	3.433	.136	66.71
33	156.50 - 157.00	18.00 - 18.50	4.174	.352	106.12	3.907	.192	98.14
34	156.50 - 157.00	18.50 - 19.00	4.187	.341	81.96	3.920	.185	67.64
35	156.50 - 157.00	19.00 - 19.50	4.260	.300	66.66	3.937	.187	24.95

SEISMIC MAP OF HAWAII

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
36	156.50 - 157.00	19.50 - 20.00	4.260	.300	45.05	3.943	.184	63.33
37	156.50 - 157.00	20.00 - 20.50	4.260	.300	69.70	3.943	.184	84.68
38	156.50 - 157.00	20.50 - 21.00	4.260	.300	86.08	3.943	.164	89.73
39	156.50 - 157.00	21.00 - 21.50	4.260	.300	83.17	3.937	.187	40.52
40	156.50 - 157.00	21.50 - 22.00	3.969	.153	89.44	3.433	.136	30.23
41	157.00 - 157.50	19.00 - 19.50	4.260	.300	96.54	3.937	.187	72.30
42	157.00 - 157.50	19.50 - 20.00	4.260	.300	86.09	3.943	.184	87.76
43	157.00 - 157.50	20.00 - 20.50	4.260	.300	57.89	3.943	.184	105.56
44	157.00 - 157.50	20.50 - 21.00	4.260	.300	100.78	3.943	.184	111.39
45	157.00 - 157.50	21.00 - 21.50	4.260	.300	61.35	3.937	.187	102.07
46	157.00 - 157.50	21.50 - 22.00	3.969	.153	105.73	3.433	.136	75.55
47	157.50 - 158.00	19.00 - 19.50	4.187	.376	125.92	3.658	.207	98.60
48	157.50 - 158.00	19.50 - 20.00	4.187	.376	117.25	3.671	.198	104.48
49	157.50 - 158.00	20.00 - 20.50	4.187	.376	113.39	3.671	.198	115.50
50	157.50 - 158.00	20.50 - 21.00	4.187	.376	125.06	3.671	.198	122.50
51	157.50 - 158.00	21.00 - 21.50	4.260	.300	133.14	3.937	.187	145.74
52	157.50 - 158.00	21.50 - 22.00	3.969	.153	132.72	3.433	.136	116.51
53	158.00 - 158.50	19.00 - 19.50	3.794	.331	141.06	3.196	.241	107.62
54	158.00 - 158.50	19.50 - 20.00	3.794	.331	130.14	3.241	.200	112.81
55	158.00 - 158.50	20.00 - 20.50	3.794	.331	126.53	3.241	.200	119.19
56	158.00 - 158.50	20.50 - 21.00	3.794	.331	130.29	3.241	.200	124.10
57	158.00 - 158.50	21.00 - 21.50	4.187	.376	172.30	3.658	.207	157.85
58	158.00 - 158.50	21.50 - 22.00	3.874	.243	158.77	3.273	.155	139.84
59	158.00 - 158.50	22.00 - 22.50	3.236	.437	127.77	2.913	.102	121.51
60	158.00 - 158.50	22.50 - 23.00	3.209	.451	152.40	2.881	.147	139.47
61	158.50 - 159.00	19.00 - 19.50	2.875	.000	136.52	3.135	.321	139.27
62	158.50 - 159.00	19.50 - 20.00	2.875	.000	121.60	3.190	.274	144.06
63	158.50 - 159.00	20.00 - 20.50	2.875	.000	113.80	3.190	.274	148.52
64	158.50 - 159.00	20.50 - 21.00	2.875	.000	112.98	3.190	.274	154.00
65	158.50 - 159.00	21.00 - 21.50	3.794	.331	172.13	3.241	.200	157.17
66	158.50 - 159.00	21.50 - 22.00	3.794	.331	186.77	2.854	.085	134.50
67	158.50 - 159.00	22.00 - 22.50	3.209	.451	153.57	2.780	.175	140.97
68	158.50 - 159.00	22.50 - 23.00	3.172	.477	175.81	2.780	.175	156.86
69	159.00 - 159.50	21.00 - 21.50	2.875	.000	149.59	3.190	.274	189.82
70	159.00 - 159.50	21.50 - 22.00	2.875	.000	161.31	2.722	.255	162.80

SEISMIC MAP OF HAWAII

GRID	LONG1 - LONG2	LAT1 - LAT2	A(H)	O(H)	R(H)	A(N)	O(N)	R(N)
71	159.00 - 159.50	22.00 - 22.50	2.699	.000	163.44	2.722	.255	170.50
72	159.00 - 159.50	22.50 - 23.00	2.398	.000	165.39	2.722	.255	184.26
73	159.50 - 160.00	21.00 - 21.50	2.699	.000	168.10	.000	.000	.00
74	159.50 - 160.00	21.50 - 22.00	2.699	.000	176.82	.000	.000	.00
75	159.50 - 160.00	22.00 - 22.50	2.699	.000	191.13	.000	.000	.00
76	159.50 - 160.00	22.50 - 23.00	2.398	.000	191.47	.000	.000	.00
77	160.00 - 160.50	21.00 - 21.50	.000	.000	.00	.000	.000	.00
78	160.00 - 160.50	21.50 - 22.00	.000	.000	.00	.000	.000	.00
79	160.00 - 160.50	22.00 - 22.50	.000	.000	.00	.000	.000	.00
80	160.00 - 160.50	22.50 - 23.00	.000	.000	.00	.000	.000	.00
81	160.50 - 161.00	21.00 - 21.50	.000	.000	.00	.000	.000	.00
82	160.50 - 161.00	21.50 - 22.00	.000	.000	.00	.000	.000	.00
83	160.50 - 161.00	22.00 - 22.50	.000	.000	.00	.000	.000	.00
84	160.50 - 161.00	22.50 - 23.00	.000	.000	.00	.000	.000	.00
85	161.00 - 161.50	21.00 - 21.50	.000	.000	.00	.000	.000	.00
86	161.00 - 161.50	21.50 - 22.00	.000	.000	.00	.000	.000	.00
87	161.00 - 161.50	22.00 - 22.50	.000	.000	.00	.000	.000	.00
88	161.00 - 161.50	22.50 - 23.00	.000	.000	.00	.000	.000	.00
89	161.50 - 162.00	21.00 - 21.50	.000	.000	.00	.000	.000	.00
90	161.50 - 162.00	21.50 - 22.00	.000	.000	.00	.000	.000	.00
91	161.50 - 162.00	22.00 - 22.50	.000	.000	.00	.000	.000	.00
92	161.50 - 162.00	22.50 - 23.00	.000	.000	.00	.000	.000	.00

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

A methodology is presented for survey and evaluation of existing buildings to determine the risk to life safety under natural hazard conditions and estimate the amount of expected damage. Damage to both structural and nonstructural building components resulting from the extreme natural environments encountered in earthquakes, hurricanes, and tornadoes is considered. The methodology has the capability of treating a large class of structural types including braced and unbraced steel frames, concrete frames with and without shear walls, bearing wall structures, and long-span roof structures. Three independent but related sets of procedures for estimating damage for each of the natural hazards are included in the methodology. The first set of procedures provides a means for qualitatively determining the damage level on the basis of data collected in field surveys of the building. The second set utilizes a structural analysis of the building to determine the damage level as a function of the behavior of critical elements. The third set is based on a computer analysis of the entire structure. All three sets of procedures are based on the current state of the art. The procedures are presented in a format which allows updating and refining. Numerical examples illustrating application of the procedures are included.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Buildings; Damage; Disaster; Dynamic Analysis; Earthquakes; Hurricanes; Natural hazards; Structural engineering; Tornadoes; Wind.

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